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ABSTRACT

Eight learning activity packets (LAPs) are provided for the instructional area of engine rebuilding in the auto mechanics II program. They accompany an instructor's guide available separately. The LAPs outline the study activities and performance tasks for these eight units: (1) engine condition evaluation; (2) engine removal; (3) engine disassembly; (4) valve train and cylinder head reconditioning; (5) engine crankshaft, bearings, and oil pump; (6) cylinder and piston reconditioning; (7) engine reassembly; and (8) engine installation. A cover sheet to each LAP sets forth purpose, an introduction, and list of tasks included. Each LAP contains these components: a checklist of learning steps, pretest (with answers), and assignment sheets (with answers). (YLB)

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State Department of Vocational and Technical Education CIMC Stillwater, Oklahoma LEARNING ACTIVITY PACKETS

for AUTO MECHANICS II

LAP NO._____ CODE:_____

MAJOR INSTRUCTIONAL AREA SECTION A--ENGINE REBUILDING

INSTRUCTIONAL UNIT UNIT I--ENGINE CONDITION EVALUATION

LEARNING ACTIVITY PACKET NO. 1

PREREQUISITE LAP(S) NONE

PURPOSE: This Learning Activity Packet (LAP) outlines the study activities and performance tasks for "Engine Condition Evaluation." Accomplishing these procedures will aid the student in attaining a working knowledge of this area of training and in achieving a SKILLED or MODERATELY SKILLED competency level in the performance of jobs associated with this specialty.

INTRODUCTION: The course of study in this LAP will help the student become able to describe possible causes of low engine oil pressure and oil consumption. The student should also be able to describe how to diagnose internal engine defects by their characteristic sounds. After completing this LAP the student will be able to perform engine compression and cylinder leakage tests.

TASKS INCLUDED IN THIS LAP:

1. Test engine compression.
2. Perform cylinder leakage test.

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SECTION A--ENGINE REBUILDING
UNIT I--ENGINE CONDITION EVALUATION

LEARNING STEPS

Check the following blanks as you complete the required steps.

_____ 1.	Read	Unit and Specific Objectives, page AM II-1-A.
_____ 2.	Complete	Engine Condition Evaluation Pretest, LAP page 7.
_____ 3.	Study	The sections of the Information Sheet (pages AM II-5-A through AM II-9-A) indicated by your instructor on your pretest.
_____ 4.	Refer	To step 8 of the pretest. If additional study is required for Information Sheet, Section I, continue to Learning Step 5. Otherwise, proceed to Learning Step 7.
_____ 5.	Do	LAP Assignment Sheet #1, LAP page 13.
_____ 6.	Do	LAP Assignment Sheet #2, LAP page 15.
_____ 7.	Refer	To Step 8 of the pretest. If additional study is required for Information Sheet, Sections II or III, continue to Learning Step 8. Otherwise, proceed to Learning Step 10.
_____ 8.	Do	LAP Assignment Sheet #3, LAP page 17.
_____ 9.	Do	LAP Assignment Sheet #4, LAP page 19.

_____10.	Refer	To step 8 of the pretest. If additional study is required for Information Sheet, Sections IV or V, continue to Learning Step 11. Otherwise, proceed to Learning Step 13.
_____11.	Do	LAP Assignment Sheet #5, LAP page 21.
_____12.	Do	LAP Assignment Sheet #6, LAP page 23.
_____13.	Refer	To Step 8 of the pretest. If additional study is required for Information Sheet, Section VI, continue to Learning Step 14. Otherwise, proceed to Learning Step 17.
_____14.	Do	Assignment Sheet #1--Complete a Chart for Troubleshooting Engine Noise, pages AM II-11-A through AM II-13-A.
_____15.	Stop.	Have your instructor evaluate your assignment sheet. If your instructor is satisfied with your performance, proceed to Learning Step 17. Otherwise, continue to Learning Step 16.
_____16.	Do	LAP Assignment Sheet #7, LAP page 25.
_____17.	Check	The tasks below which you feel that you can perform without supervision.

Student Check		Instructor Initials/Date: Skilled	Moderately Skilled
_____a.	Test engine compression (20).	_____	_____
_____b.	Perform cylinder leakage test (26).	_____	_____

____18.	Discuss	Your competency in each task with your instructor. Your instructor will initial each task in which you demonstrate sufficient competency. If both tasks have been initialed, proceed to Learning Step 32. Otherwise, continue to Learning Step 19.
____19.	Refer	To Learning Step 17a. If this task has been initialed by your instructor, proceed to Learning Step 25. Otherwise, continue to Learning Step 20.
____20.	Study	Job Sheet #1--Test Engine Compression, pages AM II-17-A through AM II-19-A.
____21.	Watch	Slide/tape presentation, "Test Engine Compression" (A-I-1).
____22.	Do	Job Sheet #1--Test Engine Compression.
____23.	Stop.	Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Learning Step 17a and proceed to Learning Step 25. Otherwise, repeat Learning Steps 20 through 22 and then continue Learning Step 24.
____24.	Stop.	Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Learning Step 17a and continue to Learning Step 25. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 17a and continue to Learning Step 25.
____25.	Refer	To Learning Step 17b. If this task has been initialed, proceed to Learning Step 32. Otherwise, continue to Learning Step 26.

_____26.	Study	Job Sheet #2--Perform Cylinder Leakage Test, pages AM II-21-A through AM II-23-A.
_____27.	Watch	Slide/tape presentation, "Perform Cylinder Leakage Test" (A-I-2).
_____28.	Do	Job Sheet #2--Perform Cylinder Leakage Test.
_____29.	Stop.	Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Learning Step 17b and continue to Learning Step 31. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 17b and continue to Learning Step 31.
_____31.	Refer	To Learning Step 17. If both tasks have been initialed, continue to Learning Step 32. Otherwise, refer to the Learning Step indicated in parentheses after the unsigned task.
_____32.	Review	Information Sheet (pages AM II-5-A through AM II-9-A) and LAP Assignment Sheets.
_____33.	Take	Engine Condition Evaluation Test (see your instructor). If your score is 85 percent or above, continue to the next assigned Learning Activity Packet. Otherwise, ask your instructor about additional study requirements and possible retesting.

SECTION A--ENGINE REBUILDING
UNIT I--ENGINE CONDITION EVALUATION

PRETEST

NAME _____ SCORE _____

DIRECTIONS: This pretest is to determine how much you already know about engine condition evaluation. Your performance on this pretest will not be used to determine your grade in the course. Instead it will guide your instructor in designing this course to meet your needs. If you are unsure of the answer to a question, do not guess. Guessing may prevent you from receiving needed instruction.

1. Describe the following terms and procedures.

   a. Blow-by--Leakage of burned and unburned combustion mixture past the piston rings and into the crankcase

   b. Piston slap--Sound made by an excessively loose piston as it "slaps" against the cylinder wall

   c. Detonation--Engine knock caused by uncontrolled second explosion of gases ahead of the flame front

   d. Decarbonizing--Process of removing carbon

   e. Preignition--Premature ignition occuring in the engine cylinder before the spark plug fires

   f. Bloc-check--Testing tool used to detect leakage of combustion gases into the cooling system

   g. Engine loading--Operating an engine under a strain

   h. PCV (positive crankcase ventilation)--Recycles blow-by gases back into intake manifold

   i. Cylinder leakage test--Pressurizing cylinder with an external air source to determine percentage and source of leakage

   j. Compression test--Measures maximum cylinder pressure under compression

2. Give six possible causes of low engine oil pressure.

ANSWER SHOULD INCLUDE ANY SIX OF THE FOLLOWING.

a. Broken regulator on oil pump

b. Worn cam bearings

c. Worn main bearings

d. Stuck regulator valve

e. Worn pump

f. Pick up screen raised above oil level in oil pan

g. Low oil level

h. Thin or diluted oil

i. Worn rod bearings

3. Give six conditions which cause excessive oil consumption.

ANSWER SHOULD INCLUDE ANY SIX OF THE FOLLOWING.

a. Worn or stuck rings

b. Worn rod bearings

c. Worn valve guides

d. Damaged or broken valve stem seals

e. Stuck PCV valve

f. Leaking intake manifold gasket

g. Oil leaks

h. Vacuum diaphram leaking

4. Give six simple inspection checks you might perform if you had to evaluate an engine's condition.

ANSWER SHOULD INCLUDE ANY SIX OF THE FOLLOWING.

a. Locations of oil leaks

b. Color of and deposits on tail pipe

c. Abrasives entering air intake

d. Excessive blowby in PCV system

e. Water or fuel in oil

f. Types of deposits on spark plugs

g. Coolant system compression leaks

h. Locations of coolant leaks

5. Before a mechanic can properly analyze an engine's internal condition, he or she must eliminate all unrelated sounds. There can be a number of things connected to the engine which might be too noisy or need adjusting and therefore prevent the mechanic from hearing and diagnosing the cause of a serious engine problem. List four possible sources of this type of noise interference.

ANSWER SHOULD INCLUDE ANY FOUR OF THE FOLLOWING.

a. Carbon deposits in cylinders

b. Torque converter drive plate

c. Torsional vibration damper

d. Accessory components

e. Flywheel drive plate

f. Heat riser valve

g. Belts

6. An experienced mechanic can quickly and accurately assess an engine's condition by the sound a particular defect will make. Every defect has an identifiable sound, and each defect has a specific testing procedure to locate and confirm the problem. Below are listed six noisemaking problems. Briefly describe the noise each type of defect makes and the test procedure to follow in diagnosing the problem. 6a has been done as an example.

a. Piston knock

Type of sound-- Hollow, high pitched, light to moderate knock

Test method-- Start engine and run at loudest knock speed. Remove and replace spark plug wires one at a time until knocking stops, indicating which piston is knocking.

b. Timing chain

Type of sound--Clicking noise, consistently loud but varying in frequency with engine speed

Test method--Listen with stethoscope to timing cover and area around it

c. Main bearings

Type of sound--Deep solid knock; becomes a rumbling noise at higher speeds

Test method--Load engine at fast idle; knock will increase and decrease with load

d. Fuel pump

Type of sound--High pitched knocking localized at pump; may be intermittent

Test method--Listen to fuel pump and surrounding area; knocking should be loudest at the fuel pump

e. Rod bearing

Type of sound--Sharp solid knock in lower part in engine; sounds like hammering on a solid steel bar

Test method--When running engine at fast idle with no load, bearing should knock; noise should lessen or disappear as load is increased Determine which rod bearing is bad by pulling spark plug wires one at a time. When cylinder with the knocking bearing has wire removed, a double knock will be heard; single knock returns as wire is replaced

f. Valve train

Type of sound--Variety of light to moderate knocks, chatters, pecks, or squeaks

Test method--Remove valve cover and inspect for broken or damaged parts. Start engine and observe valve operation; look for excessive valve lash

g. Wrist pin

Type of sound--Solid knock, but lighter than rod or main bearings; usually double in frequency

Test method--Raise and lower engine speed; knocking or double knocking should increase as engine is accelerated

7. Answer the following questions about procedures related to engine condition evaluation.

   a. Describe compression tests and the results of their comparison.

      DESCRIPTION SHOULD INCLUDE THE FOLLOWING STEPS.

      1) Briefly describe the procedure for a dry compression test.

         a) Warm engine to normal temperature

         b) Remove air cleaner

         c) Remove coil wire to distributor

         d) Block carburetor and choke valves wide open

         e) Remove spark plugs

         f) Double-check battery condition and charge level

         g) Attach remote starter to solenoid or relay

         h) Install compression hose and gauge to No. 1 cylinder

         i) Crank engine to obtain five compression strokes

         j) Record gauge reading

         k) Repeat steps 8 through 10 for remaining cylinders

      2) Briefly describe the procedure for performing a wet compression test.

         DESCRIPTION SHOULD INCLUDE THE FOLLOWING STEPS.

         a) Inject 2 tablespoons of 30W motor oil into each cylinder

         b) Connect remote starter switch to solenoid or relay

         c) Install compression gauge hose in No. 1 cylinder

         d) Connect hose to gauge

         e) Crank engine to obtain five compression strokes

         f) Record gauge reading

         g) Repeat steps C through F for each remaining cylinder

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3) What will comparing wet and dry compression readings tell the mechanic about the engine?

Comparison identifies defective components in the engine. If wet test is 15 psi or more above the dry test, then the piston rings are bad. If the two tests are nearly the same compression, then valves or head gaskets are bad

b. Describe how to perform a cylinder leakage test.

DESCRIPTION SHOULD INCLUDE THE FOLLOWING STEPS.

1) Warm up engine to normal temperature
2) Remove air cleaner, spark plugs, and coil wire
3) Block carburetor throttle and choke valves wide open
4) Remove radiator cap and oil cap
5) Insert adapter into No. 1 cylinder
6) Attach whistle to adapter
7) Rotate engine very slowly until whistle sounds
8) Adjust leakage tester according to manufacturer's instructions
9) Connect tester hose to adapter
10) Record percentage of leakage on tester gauge
11) Check for escaping air from carburetor, exhaust, crankcase filler pipe, or radiator
12) Test remaining cylinders

8. Stop. Have your instructor evaluate your pretest and mark the area(s) below requiring additional study.

Refer to Information Sheet, Section(s)

___ I ___ IV

___ II ___ V

___ III ___ VI

You came here from Learning Step 2. If none of the above sections are checked, proceed to Learning Step 17. Otherwise, continue to Learning Step 3.

SECTION A--ENGINE REBUILDING
UNIT I--ENGINE CONDITION EVALUATION

LAP ASSIGNMENT SHEET #1

NAME_____ SCORE_____

A. Match the following terms and definitions associated with engine condition evaluation. Write the correct letters in the blanks.

__d__	1. Engine knock caused by uncontrolled second explosion ahead of the combustion front	a.	Blow-by
		b.	Bloc-check
__e__	2. Measures maximum pressure inside the cylinder	c.	Crankcase ventilation system
__g__	3. Process of removing carbon	d.	Piston slap
__f__	4. Leakage of combustion mixture and gases past the piston rings	e.	Preignition
		f.	Detonation
__j__	5. Detects leakage of combustion gases into the cooling system	g.	Compression test
__a__	6. Sound made by excessively loose piston	h.	Cylinder leakage test
__b__	7. Permits air to flow through engine crankcase	i.	Decarbonization
		j.	Engine loading
__i__	8. Operating engine under a strain		
__c__	9. Determines what part of the cylinder is causing the leak		
__h__	10. Premature ignition in the cylinder before the spark plug fires		

B. Stop. Have your instructor evaluate your Assignment Sheet and mark the area(s) below requiring additional study.

Refer to Information Sheet, Section(s)

___ I	___ III	___ V
___ II	___ IV	___ VI

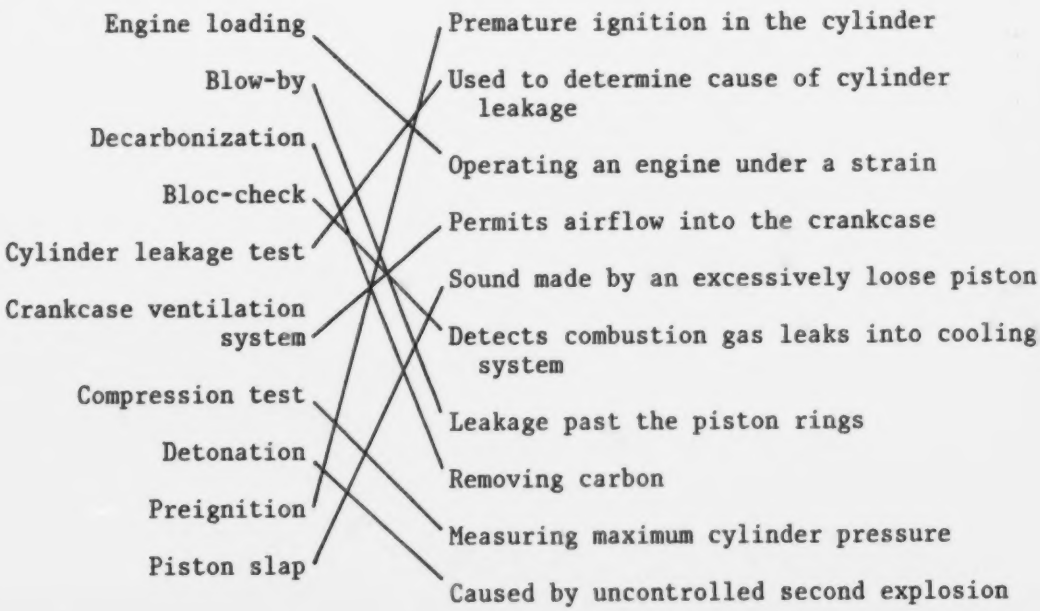
If none of the above sections are checked, proceed to Learning Step 7. Otherwise, study the required section(s) and then continue to Learning Step 6.

SECTION A--ENGINE REBUILDING
UNIT I--ENGINE CONDITION EVALUATION

LAP ASSIGNMENT SHEET #2

NAME_____ SCORE_____

A. Draw a line to connect each of the following terms to its correct definition.



B. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your progress, continue to Learning Step 7. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to Learning Step 7.

SECTION A--ENGINE REBUILDING
UNIT I--ENGINE CONDITION EVALUATION

LAP ASSIGNMENT SHEET #3

NAME_____ SCORE_____

A. Below are listed ten conditions which can cause low oil pressure or high oil consumption. In the blank next to each condition put a "+" (plus sign) if the condition causes low oil pressure or a 0 (zero) if the condition will cause high oil consumption.

_+_ 1. Worn oil pump

_0_ 2. Stuck PCV valve

_0_ 3. External oil leaks

_+_ 4. Stuck oil pressure regulator valve

_+_ 5. Diluted oil

_0_ 6. Worn piston rings

_+_ 7. Worn main bearings

_0_ 8. Leaking intake manifold gasket

_0_ 9. Leaking vacuum diaphragm on a double disc diaphragm fuel pump

_+_ 10. Broken push rod

B. What engine condition will both reduce oil pressure and increase oil consumption?

Worn rod bearings

C. Stop. Have your instructor evaluate your Assignment Sheet and mark the area(s) below requiring additional study.

Refer to Information Sheet, Section(s)

___ I ___ III ___ V

___ II ___ IV ___ VI

If none of the above sections are checked, proceed to Learning Step 10. Otherwise, study the required section(s) and then continue to Learning Step 9.

SECTION A--ENGINE REBUILDING
UNIT I--ENGINE CONDITION EVALUATION

LAP ASSIGNMENT SHEET #4

NAME _____ SCORE _____

A. List nine possible causes of low oil pressure.

1. Worn connecting rod bearings
2. Worn main bearings
3. Worn cam bearings
4. Worn oil pump
5. Stuck oil pressure regulator valve
6. Broken pressure regulator valve spring in oil pump
7. Oil pickup screen raised above oil level in oil pan
8. Leakage in valve train from bent, broken or leaking parts
9. Thin or diluted oil

B. List eight causes of high oil consumption.

1. Worn or stuck piston rings
2. Worn rod bearings
3. Worn valve grinder
4. Damaged or broken valve stem seals
5. Stuck PCV valve
6. Leaking intake manifold gasket
7. External oil leaks
8. Vacuum diaphram leaking on a double diaphram fuel pump

C. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your progress, continue to Learning Step 10. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to Learning Step 10.

SECTION A--ENGINE REBUILDING
UNIT I--ENGINE CONDITION EVALUATION

LAP ASSIGNMENT SHEET #5

NAME _____ SCORE _____

Fill in the missing words in the statements that follow.

A. When inspecting an engine to evaluate its internal condition there are several things to check.

1. Check the engine oil for water or fuel contamination.
2. Check spark plugs for deposits on the electrodes.
3. Perform a bloc-check test on the cooling system.
4. Check the tail pipe for color and deposits.

   Light to medium gray indicates normal

   Dark gray indicates too much oil

   Black indicates too much fuel

   White or light brown indicates coolant in the cylinder
5. Check the location of oil or coolant leaks.
6. Check for excessive blow-by through the crankcase ventilation system.
7. Check the air filter for dust or abrasives entering the intake.

B. Before attempting to analyze an internal engine noise there are certain items which should be checked.

1. Check the fan or accessory drive belts for cracks or missing sections.
2. Three examples of potentially noisy accessories are the air pump, the air conditioning compressor, and the alternator or generator.

3. Check the __torsional__ vibration damper for __looseness__ or improper __installation__.

4. Check the flywheel or torque converter __drive__ __plate__ for loose bolts.

5. Check the torque converter drive plate for __cracks__ between the __hub__ area and the converter's attaching __bolts__.

6. Check the heat riser for a broken __spring__.

7. Inspect the cylinders for __carbon__ deposits.

C. Stop. Have your instructor evaluate your Assignment Sheet and mark the area(s) below requiring additional study.

Refer to Information Sheet, Section(s)

____ I ____ III ____ V

____ II ____ IV ____ VI

If none of the above sections are checked, proceed to Learning Step 13. Otherwise, study the required section(s) and then continue to Learning Step 12.

SECTION A--ENGINE REBUILDING
UNIT I--ENGINE CONDITION EVALUATION

LAP ASSIGNMENT SHEET #6

NAME _____ SCORE _____

A. Following is a list of items that should be inspected to evaluate the engine's condition. Explain what you should be looking for on each inspection.

1. Engine oil--Contamination by water or fuel in the oil

2. Spark plugs--Types of deposits on electrons

3. Bloc-check--Combustion gases in coolant system

4. Tail pipe--Color and deposits; light gray is normal, dark gray indicates excessive oil burning, black indicates too much fuel is burning, white or light brown indicates coolant in combustion chamber

5. Oil and coolant leaks--Locations

6. Crankcase ventilation system--Excessive blow-by

7. Air filter--Evidence of dust abrasives entering through intake manifold

B. Careful listening can tell you a lot about the internal workings of an engine. But before you can perform a test there are several potential sources of noise interference from other things on or around the engine. Following are listed some of these sources of interference. Describe what you should be looking for as you inspect each one.

1. Fan and accessory drive belts--Cracks or missing core sections

2. Air conditioning compressor, alternator, and air pump-- Noisy operations

3. Torsional vibration damper-- Looseness or improper installation

4. Flywheel and torque converter drive plates-- Loose bolts

5. Torque converter drive plate, hub area-- Cracks between hub area and converter attaching bolts

6. Heat riser-- Broken spring

7. Cylinders-- Carbon deposits

C. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your progress, continue to Learning Step 13. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to Learning Step 13.

SECTION A--ENGINE REBUILDING
UNIT I--ENGINE CONDITION EVALUATION

LAP ASSIGNMENT SHEET #7

NAME _____ SCORE _____

A. You can hear a variety of light to moderate knocks, chatters, pecks or squeaks.

Probable cause--Valve train

Test method--Remove valve cover and inspect for broken or damaged parts. Start engine and observe valve operations; look for excessive valve lash

B. It's a sharp, distinct high-pitched knock. Intermittent sound seems to be around the fuel pump.

Probable cause--Fuel pump

Test method--Listen to fuel pump and surrounding area with a stethoscope; knocking should be loudest at the fuel pump

C. You hear a deep solid knock. When you rev the engine it becomes more like a rumbling noise.

Probable cause--Main bearings

Test method--Load the engine at fast idle; knock will increase and decrease with load

D. You hear a hollow sound, higher pitched, with a light to moderate knock.

Probable cause--Piston knock

Test method--Start engine and run at loudest knock speed; knock will lessen as engine warms up. Remove and replace spark plug wires one at a time until knocking stops, indicating which piston is knocking

E. The noise sounds like a hammer hitting a solid steel bar. A sharp, solid knock comes from the lower part of the engine.

Probable cause--Rod bearing

Test method--When running engine at fast idle with no load, bearing should knock; noise should lessen or disappear as load is increased. Knocking bearing has wire removed, a double knock is heard; single knock returns as wire is replaced

F. The clicking noise is consistently loud but varies in frequency with engine speed.

Probable cause--Timing chain

Test method--Listen with stethoscope to timing cover and sorrounding area

G. The knock is solid or may be a double knock of varying frequency.

Probable cause--Wrist pin

Test method--Raise and lower engine speed; knocking or double knocking sound should increase as engine is accelerated; decelerate and double knock should stay about the same

H. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your progress, continue to Learning Step 17. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to Learning Step 17.

State Department of Vocational and Technical Education CIMC Stillwater, Oklahoma LEARNING ACTIVITY PACKETS

for AUTO MECHANICS II

LAP NO._____ CODE:_____

MAJOR INSTRUCTIONAL AREA SECTION A--ENGINE REBUILDING

INSTRUCTIONAL UNIT UNIT II--ENGINE REMOVAL

LEARNING ACTIVITY PACKET NO. 2

PREREQUISITE LAP(S) NONE

PURPOSE: This Learning Activity Packet (LAP) outlines the study activities and performance tasks for "Engine Removal." Accomplishing these procedures will aid the student in attaining a working knowledge of this area of training and in achieving a SKILLED or MODERATELY SKILLED competency level in the performance of jobs associated with this specialty.

INTRODUCTION: The course of study in this LAP will help the student become able to safely and efficiently remove an automobile engine. After completing this LAP the student will be able to remove engines with automatic and standard transmissions.

TASKS INCLUDED IN THIS LAP:

1. Remove an engine with an automatic transmission.
2. Remove an engine with a standard transmission.

SECTION A--ENGINE REBUILDING
UNIT II--ENGINE REMOVAL

LEARNING STEPS

Check the following blanks as you complete the required steps.

_____ 1. Read — Unit and Specific Objectives, page AM II-35-A.

_____ 2. Complete — Engine Removal Pretest, LAP page 7.

_____ 3. Study — The sections of the Information Sheet (pages AM II-39-A through AM II-41-A) indicated by your instructor on the pretest.

_____ 4. Refer — To Step 6 of the pretest. If additional study is required for Information Sheet, Sections I through IV, continue to Learning Step 5. Otherwise, proceed to Learning Step 7.

_____ 5. Do — LAP Assignment Sheet #1, LAP page 11.

_____ 6. Do — LAP Assignment Sheet #2, LAP page 15.

_____ 7. Check — The tasks below which you feel that you can perform without supervision.

Student Check		Instructor Initials/Date: Skilled	Moderately Skilled
____a.	Remove an engine with an automatic transmission (11).	_____	_____
____b.	Remove an engine with a standard transmission (17).	_____	_____

_____ 8.	Discuss	Your competency in each task with your instructor. Your instructor will initial each task in which you demonstrated sufficient competency. If both tasks have been initialed proceed to Learning Step 21. Otherwise, continue to Learning Step 9.
_____ 9.	Study	Job Sheet #1--Remove an Engine With an Automatic Transmission, pages AM II-43-A through 54-A.
_____10.	Watch	Slide/tape presentation, "Remove an Engine With an Automatic Transmission" (A-II-1).
_____11.	Do	Job Sheet #1--Remove an Engine With an Automatic Transmission.
_____12.	Stop.	Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Learning Step 7a and proceed to Learning Step 14. Otherwise, repeat Learning Steps 9 through 11 and continue to Learning Step 13.
_____13.	Stop.	Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Learning Step 7a and continue to Learning Step 14. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 7a and continue to Learning Step 14.
_____14.	Refer	To Learning Step 7b. If this task has been initialed, proceed to Learning Step 20. Otherwise, continue to Learning Step 15.
_____15.	Study	Job Sheet #2--Remove an Engine with a Standard Transmission, pages AM II-55-A through AM II-67-A.

_____16.	Watch	Slide/tape presentation, "Remove an Engine with a Standard Transmission" (A-II-2).
_____17.	Do	Job Sheet #2--Remove an Engine with a Standard Transmission.
_____18.	Stop.	Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Learning Step 7b and proceed to Learning Step 20. Otherwise, repeat Learning Steps 15 through 17 and continue to Learning Step 19.
_____19.	Stop.	Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Learning Step 7b and continue to Learning Step 20. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 7b and continue to Learning Step 20.
_____20.	Refer	To Learning Step 7. If both tasks have been initialed, continue to Learning Step 21. Otherwise, refer to the learning step indicated in parentheses after the unsigned task.
_____21.	Review	Information Sheet (pages AM II-39-A through AM II-41-A) and LAP Assignment Sheets.
_____22.	Take	Engine Removal Test (see your instructor). If your score is 85 percent or above, continue to the next assigned Learning Activity Packet. Otherwise, ask your instructor about additional study requirements and possible retesting.

SECTION A--ENGINE REBUILDING
UNIT II--ENGINE REMOVAL

PRETEST

NAME_____ SCORE_____

DIRECTIONS: This pretest is to determine how much you already know about engine removal. Your performance on this pretest will not be used to determine your grade in the course. Instead, it will guide your instructor in designing this course to meet your needs. If you are unsure of the answer to a question, do not guess. Guessing may prevent you from receiving needed instruction.

1. Define the following terms associated with engine removal.

   a. Bell housing--Covering around flywheel and clutch or torque converter assembly

   b. Firewall--Metal wall or divider between engine and passenger compartments

   c. Cowel--Section of the car body between the firewall and the front of the dash panel

   d. Splash shield (apron)--Metal liner in the front fender; separates wheels from engine compartment

   e. Radiator support--Metal support between front fenders that braces the radiator, fenders, and air conditioning condenser

   f. Air conditioning condenser--Component of the air conditioning system; usually mounted in front of the radiator

   g. Air conditioning evaporator--Component of the air conditioning system; usually mounted on the firewall

   h. Schrader valve--Valve located inside service fitting on air conditioning system; resembles a tire valve

   i. Engine repair stand--Portable fixture used to hold engine so that it can be turned and moved to make repair work easier

2. List seven safety rules to observe when removing an engine.

ANSWER SHOULD INCLUDE ANY SEVEN OF THE FOLLOWING.

a. Determine if hoist capacity is adequate

b. Stand clear of supported engine

c. Do not work underneath the car when hoisting the engine

d. Double check all equipment connections before lifting engine

e. Tighten all lift adapter bolts securely and evenly

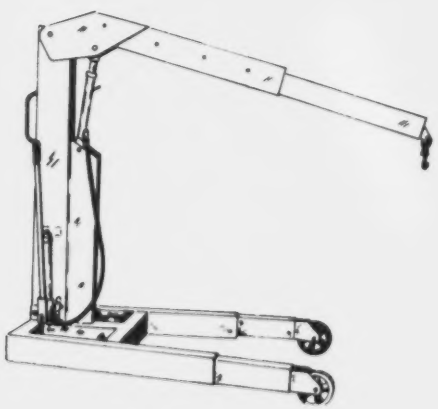
f. Do not raise engine higher than necessary

g. Lower engine to floor level as soon as possible

h. Do not work on an engine supported only by a hoist

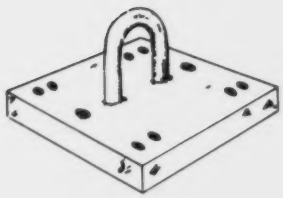
i. Be sure you have enough space to work

3. Identify the following types of engine removal tools. Write the correct names in the blanks below the illustrations.

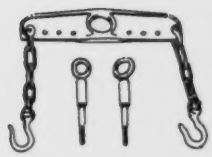


a. Chain hoist

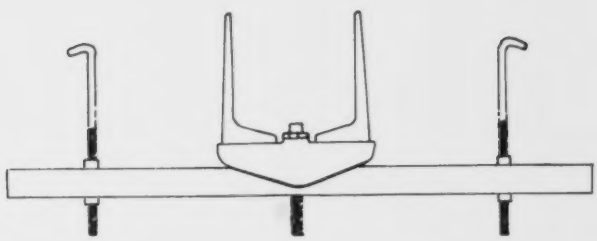
b. Hydraulic lift



c. Engine lift adapter



d. Engine lift adapter



e. Engine or transmission support

4. Arrange in order the steps for planning engine removal. Write a "1" before the first step, a "2" before the second step, and so on.

__4__ a. Keep bolts, brackets, and other items that are removed from each side of the engine compartment in separate and marked containers

__5__ b. Raise the vehicle and disconnect all items under the vehicle

__2__ c. Provide ample room around the vehicle for work

__1__ d. Prepare storage for radiator, hood, and other parts to be removed

__7__ e. Lower vehicle to the floor

__3__ f. Remove or disconnect as many parts as possible by working from over the fender

__6__ g. Remove and store parts from beneath the car in a marked parts tray

5. Describe the basic difference between removing an engine with a standard transmission and removing an engine with an automatic transmission.

The standard transmission is left attached to the engine when the engine is removed; the automatic transmission is removed separately

6. Stop. Have your instructor evaluate your pretest and mark the area(s) below requiring additional study.

Refer to Information Sheet, Section(s)

___ I ___ III

___ II ___ IV

You came here from Learning Step 2. If none of the above sections are checked, proceed to Learning Step 7. Otherwise, continue to Learning Step 3.

SECTION A--ENGINE REBUILDING
UNIT II--ENGINE REMOVAL

LAP ASSIGNMENT SHEET #1

NAME_____ SCORE_____

A. Fill in the missing terms for the following definitions.

1. Firewall --The metal wall between the engine and passenger compartments.

2. Cowel --Part of the car located between the fire wall and the front of the dash panel.

3. Bell housing --Covering around flywheel and clutch or torque converter.

4. Splash shield --Separates the front wheel compartments from the engine compartments.

5. Radiator support --Metal yoke between the front fenders that supports the air conditioning condenser and radiator.

6. Air conditioning condenser --Component of the air conditioning system mounted on the radiator support.

7. Air conditioning evaporator --Component of the air conditioning system mounted on the firewall.

8. Shrader valve --Located on the service fitting of the air conditioning system; resembles a tire valve.

9. Engine repair stand --Tool for holding the engine as the mechanic works on the engine.

B. Answer the following questions about safety rules to use when removing an engine.

1. Why is it important to determine hoist capacity before lifting an engine?

An overloaded hoist may fail and drop the engine

2. How high should you lift the engine as you remove it from the car?

Only as high as necessary to clear the vehicle

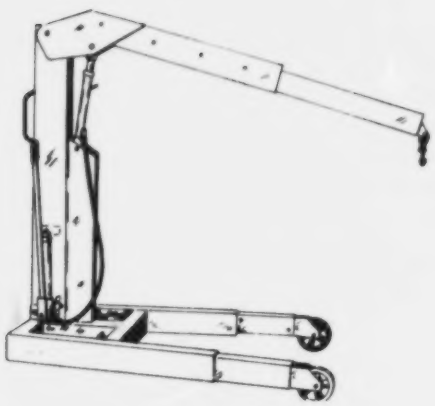
3. What is the first thing you should do with the engine after you have lifted it out of the vehicle?

Lower the engine near floor level

4. Why should you never work on an engine that is supported only by the hoist?

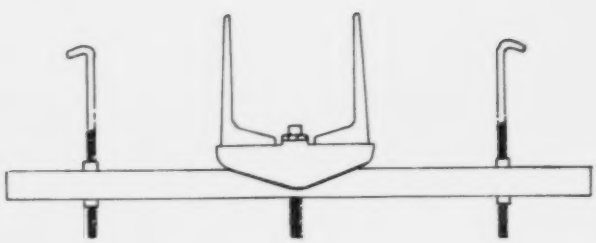
Lift could fail, causing the engine to fall

C. Identify the following special engine lifting tools and equipment. Write the correct names in the blanks below the illustrations.

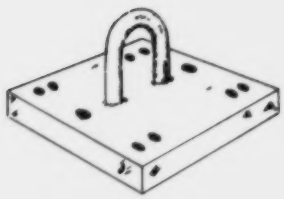


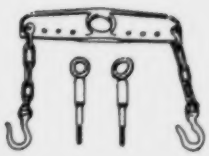
1. Hydraulic lift

2. Chain hoist



3. Engine or transmission support





4. Engine lift adapter

5. Engine lift adapter

D. List in order the seven basic steps for planning engine removal.

1. Prepare storage for radiator, hood, and other items removed during engine removal
2. Provide ample room around vehicle for work and type of hoist used
3. Remove or disconnect as many parts as possible by working over the fender
4. Remove bolts, clips and brackets from each side of the engine compartment and place them in separate, labeled containers
5. Raise vehicle and disconnect all items underneath vehicle
6. Remove bolts, clips and brackets from underside of vehicle and place them in separate, labeled containers
7. Lower vehicle to the floor before removing the engine

E. Stop. Have your instructor evaluate your Assignment Sheet and mark the area(s) below requiring additional study.

Refer to Information Sheet, Section(s)

___ I ___ III

___ II ___ IV

If none of the above sections are checked, proceed to Learning Step 7. Otherwise, study the required section(s) and then continue to Learning Step 6.

SECTION A--ENGINE REBUILDING
UNIT II--ENGINE REMOVAL

LAP ASSIGNMENT SHEET #2

NAME_____ SCORE_____

A. Match the following terms and definitions. Write the correct letters in the blanks.

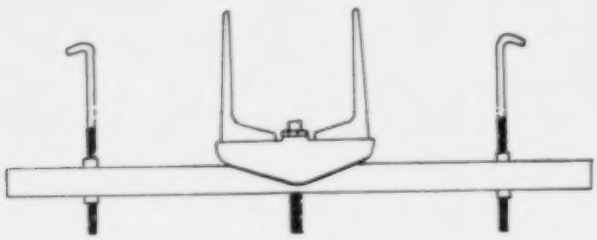
b	1. Metal wall between engine and passenger compartments	a.	Bell housing
		b.	Firewall
c	2. Part of the car body between the firewall and the front of the dash panel	c.	Cowel
		d.	Splash shield
a	3. Metal covering around the flywheel and the clutch or torque converter	e.	Air conditioning evaporator
d	4. Metal liner in front of fender; separates wheel compartment from engine compartments	f.	Radiator support
		g.	Air conditioning condenser
f	5. Supports the front fenders, radiator, and air conditioning compressor	h.	Engine repair stand
g	6. Air conditioning system component mounted on the radiator support	i.	Schrader valve
e	7. Air conditioning system component mounted on the firewall		
i	8. Resembles a tire valve; located on the service fitting of the air conditioning system		
h	9. Portable tool on which an engine can be mounted		

B. Complete the following statements about safety rules to use when removing an engine.

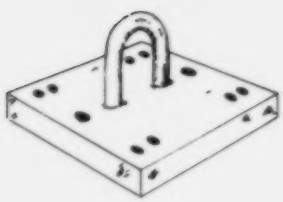
1. Make sure your hoist's ___capacity___ is sufficient to lift the engine.
2. Stand ___clear___ of any engine supported only by a hoist.
3. Never work ___under___ any vehicle while the engine is being lifted by a hoist.
4. Check all ___equipment___ ___connections___ before lifting the engine.

5. Tighten lift adapter belts evenly.

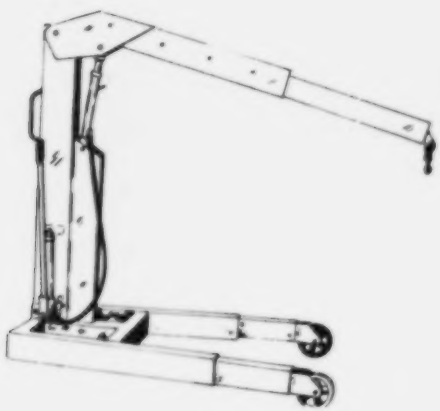
C. Write the correct name for each of the following tools in the blank below each illustration.



1. Engine or transmission support

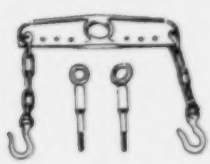


2. Engine lift adapter



3. Hydraulic lift

4. Chain hoist



5. Engine lift adapter

D. In your own words, give the steps for planning an engine removal.

ANSWER SHOULD INCLUDE THE FOLLOWING STEPS.

a. Prepare storage area for parts to be removed from vehicle

b. Provide enough working space around the vehicle for mechanics and hoist

c. Disconnect and remove as many parts as possible from above the fender

d. Store bolts, clips, and brackets removed from the engine compartment in separate, labeled containers for each side of the engine

e. Raise the vehicle and remove as many parts as possible from underneath the engine

f. Store all parts removed from underside of engine in labeled containers

g. Lower vehicle to the floor before removing the engine

E. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your progress, continue to Learning Step 7. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to Learning Step 7.

State Department of Vocational and Technical Education CIMC Stillwater, Oklahoma LEARNING ACTIVITY PACKETS

for AUTO MECHANICS II

LAP NO._____ CODE:_____

MAJOR INSTRUCTIONAL AREA SECTION A--ENGINE REBUILDING

INSTRUCTIONAL UNIT UNIT III--ENGINE DISASSEMBLY

LEARNING ACTIVITY PACKET NO.	PREREQUISITE LAP(S)
3	NONE

PURPOSE: This Learning Activity Packet (LAP) outlines the study activities and performance tasks for "Engine Disassembly." Accomplishing these procedures will aid the student in attaining a working knowledge of this area of training and in achieving a SKILLED or MODERATELY SKILLED competency level in the performance of jobs associated with this specialty.

INTRODUCTION: The course of study in this LAP will help the student become able to describe how to prepare the work area and disassemble an engine while visually inspecting each component for damage. After completing this LAP the student should be able to clean the outside of an engine and disassemble an engine.

TASKS INCLUDED IN THIS LAP:

1. Clean outside of engine.
2. Disassemble an engine.

SECTION A--ENGINE REBUILDING
UNIT III--ENGINE DISASSEMBLY

LEARNING STEPS

Check the following blanks as you complete the required steps.

_____ 1. Read — Unit and Specific Objectives, page AM II-75-A.

_____ 2. Complete — Engine Disassembly Pretest, LAP page 7.

_____ 3. Study — The sections of the Information Sheet, pages AM II-79-A and AM II-80-A.

_____ 4. Refer — To Step 9 of the Pretest. If additional study is required continue to Learning Step 5. Otherwise, proceed to Learning Step 7.

_____ 5. Do — LAP Assignment Sheet #1, LAP page 11.

_____ 6. Do — LAP Assignment Sheet #2, LAP page 13.

_____ 7. Check — The tasks below which you feel that you can perform without supervision.

Student Check		Instructor Initials/Date: Skilled	Moderately Skilled
_____a.	Clean outside of engine (12).	_____	_____
_____b.	Disassemble an engine (18).	_____	_____

_____ 8.	Discuss	Your competency in each task with your instructor. Your instructor will initial each task in which you demonstrate sufficient competency. If both tasks have been initialed, proceed to Learning Step 22. Otherwise, continue to Learning Step 9.
_____ 9.	Refer	To Learning Step 7a. If this task has been initialed, proceed to Learning Step 15. Otherwise, continue to Learning Step 10.
_____10.	Study	Job Sheet #1--Clean Outside of Engine, page AM II-81-A.
_____11.	Watch	Slide/tape presentation, "Clean Outside of Engine" (A-III-1).
_____12.	Do	Job Sheet #1--Clean Outside of Engine.
_____13.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7a and proceed to Learning Step 15. Otherwise, repeat Learning Steps 10 through 12 and continue to Learning Step 14.
_____14.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7a and continue to Learning Step 15. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 7a and continue to Learning Step 15.
_____15.	Refer	To Learning Step 7b. If this task has been initialed, proceed to Learning Step 21. Otherwise continue to Learning Step 16.

LEARNING STEPS

_____16.	Study	Job Sheet #2--Disassemble an Engine, pages AM II-83-A through 92-A.
_____17.	Watch	Slide/tape presentation, "Disassemble an Engine" (A-III-2).
_____18.	Do	Job Sheet #2--Disassemble an Engine.
_____19.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7b and proceed to Learning Step 21. Otherwise, repeat Learning Steps 16 through 18 and continue to Learning Step 20.
_____20.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7b and continue to Learning Step 21.
_____22.	Review	Information Sheet (pages AM II-79-A and 80-A) and LAP Assignment Sheets.
_____23.	Take	Engine Disassembly Test (see your instructor). If your score is 85 percent or above, continue to the next assigned Learning Activity Packet. Otherwise, ask your instructor about additional study requirements and possible retesting.

SECTION A--ENGINE REBUILDING
UNIT III--ENGINE DISASSEMBLY

PRETEST

NAME _____ SCORE _____

DIRECTIONS: This pretest is to determine how much you already know about engine disassembly. Your performance on this pretest will not be used to determine your grade in the course. Instead, it will guide your instructor in designing this course to meet your needs. If you are unsure of the answer to a question, do not guess. Guessing may prevent you from receiving needed instruction.

1. Explain the purpose or function of each of the following.

   a. Steam cleaner-- Used to remove heavy oil and dirt from the outside of the engine

   b. Engine repair stand-- Holds and supports engine during disassembly and reassembly; holds engine in a variety of positions for easy access during repairs

2. In your own words, list four safety rules to follow during engine disassembly.

   ANSWER SHOULD INCLUDE ANY FOUR OF THE FOLLOWING.

   a. Keep work area and floor clean and dry

   b. Get help when handling heavy components

   c. Be sure engine is securely attached to engine stand

   d. Keep tools and work bench clean and orderly

   e. Be sure engine weight is centered on the repair stand pivot

3. List four factors to consider when preparing to disassemble an engine.

   ANSWER SHOULD INCLUDE ANY FOUR OF THE FOLLOWING.

   a. Work area is adequate

   b. Storage of parts and subsassemblies is clean and orderly

   c. Outside of engine is cleaned as much as possible

   d. Storage is provided for bolts, clips, springs, and other subassemblies

   e. Sketch is made of accessories that may be difficult to reinstall

4. List ten items to inspect during engine disassembly.

ANSWER SHOULD INCLUDE ANY TEN OF THE FOLLOWING.

a. Cylinder head

b. Valve train

c. Cylinder block

d. Cylinder head gaskets

e. Crankshaft journals

f. Camshaft

g. Crankshaft bearings

h. Crankshaft journals

i. Bolt hole threads

j. Valve

k. Cylinder block water jacket

l. Cylinder block expansion plugs

5. Answer the following questions about cleaning and disassembling an engine.

a. Describe how to prepare and clean the outside of an engine.

DESCRIPTION SHOULD INCLUDE THE FOLLOWING STEPS.

1) Seal all engine and accessory openings

2) Remove and label all drive belts

3) Remove electrical components and wiring

4) Scrape heavy oil and dirt off the engine

5) Apply degreaser and allow to soak 30 minutes

6) Spray engine with a stream cleaner or a high pressure hot water sprayer

7) Rinse engine with water

8) Remove tape seals and prepare to disassemble

b. Answer the following questions about the procedure for disassembling an engine.

1) List ten of the engine accessories and exterior components that must be removed after the engine is firmly attached to the engine repair stand.

ANSWER SHOULD INCLUDE ANY TEN OF THE FOLLOWING ITEMS.

a) Air conditioning compressor

b) Power steering pump

c) Air pump (anti-pollution equipment)

d) Alternator

e) Distributor

f) Coil

g) Fuel Pump

h) Exhaust manifolds

i) Intake manifold

j) Torsional vibration damper

k) Drive pulley assembly

2) Describe the proper procedure for removing a cylinder head.

ANSWER SHOULD INCLUDE THE FOLLOWING STEPS.

a) Remove all inspection covers

b) Remove rocker arm covers and rocker arms

c) Remove push rods and store in sequence

d) Remove braces or accessories on cylinder head

e) Remove cylinder head bolts

f) Remove cylinder head by prying gently

g) Be careful not to damage machined surfaces as gasket seal is broken

3) List five items to inspect after removal of the cylinder head and describe what to look for during each inspection.

a) Cylinder head--Evidence of burning

b) Valves--Evidence of burning

c) Rocker arms--Cracking

d) Push rods--Bending or breaking

e) Valve springs--Breaking

4) What will happen when the pistons are removed if the ring ridge has not been properly removed? Piston ring lands will be damaged

5) What two things should you be looking for and noting when removing the connecting rod and main bearing caps? Condition of bearings and sequence or identification numbers on caps

6) What tool should you use to push the piston and connecting rod out of the engine block after the rod caps have been removed?

Wooden hammer handle

7) What should you do with the bearing caps, bolts, and nuts after all pistons and the crankshaft have been removed from the block?

Keep in their original order and replace the rod caps with their original rods

8) What types of things should you be looking for as each part is removed from the block? Wear, damage, or any other problem that may require additional parts to be purchased

6. Stop. Have your instructor evaluate your pretest and mark the area(s) below requiring additional study.

Refer to Information Sheet, Section(s)

____I ____III

____II ____IV

You came here from Learning Step 2. If none of the above sections are checked, proceed to Learning Step 7. Otherwise, continue to Learning Step 3.

SECTION A--ENGINE REBUILDING
UNIT III--ENGINE DISASSEMBLY

LAP ASSIGNMENT SHEET #1

NAME _____ SCORE _____

A. Match terms and definitions related to engine disassembly. Write the correct letters in the blanks.

c	1. Complete engine component groups	a.	Engine repair stand
b	2. Used to clean outside of an engine	b.	Steam cleaner
a	3. Supports entire engine during repairs	c.	Engine subassemblies
d	4. Systematic approach to removing engine parts	d.	Engine disassembly and inspection

B. List five safety precautions to follow during engine disassembly.

1. Keep work area floor clean and dry
2. Get help when moving heavy engine assemblies
3. Securely attach engine to the repair stand
4. Center engine weight on repair stand pivot
5. Keep tools, bench, and work area clean and organized

C. List five factors to consider in preparing to disassemble an engine.

1. Clean the engine as much as possible
2. Provide a clean, safe place to store parts
3. Have storage trays ready for bolts, clips, springs, and other parts
4. Keep special braces, spacers, and bolts with their original subassemblies
5. Sketch accessories that may be difficult to reinstall

D. List ten items to inspect during engine disassembly.

1. Cylinder head gaskets
2. Cylinder head

3. Valve train

4. Cylinder block water jacket

5. Cylinder block expansion plugs

6. Cylinder block

7. Crankshaft journals and bearings

8. Camshaft

9. Bolt hole threads

10. All observable parts

E. Stop. Have your instructor evaluate your Assignment Sheet and mark the area(s) below requiring additional study.

Refer to Information Sheet, Section(s)

_____I _____III

_____II _____IV

If none of the above sections are checked, proceed to Learning Step 7. Otherwise, study the required section(s) and then continue to Learning Step 6.

SECTION A--ENGINE REBUILDING
UNIT III--ENGINE DISASSEMBLY

LAP ASSIGNMENT SHEET #2

NAME _____ SCORE _____

A. Define the following terms related to engine disassembly.

1. Engine subassembly--Complete engine components, such as the cylinder heat, water pump, or intake manifold
2. Engine disassembly and inspection--System of removing parts and subassemblies in sequence while looking for worn or damaged parts
3. Engine repair stand--Used to support the engine during disassembly; allows the mechanic to turn the engine around for more convenient repairs
4. Steam cleaner--Heats water to steam and mixes in detergent; used to clean outside of engine

B. List five safety rules to follow during engine disassembly.

1. Keep work area floor clean and dry
2. Get help whenever moving heavy engine components
3. Make sure engine is securely attached to repair stand
4. Center engine weight on repair stand pivot
5. Keep tools and bench clean and orderly

C. List five factors to consider when preparing to disassemble an engine.

1. Clean the engine as much as possible
2. Provide a secure area for storage of parts and subassemblies
3. Organize storage trays for subassemblies and parts
4. Keep all braces and brackets with each subassembly
5. Sketch subassemblies that may be difficult to reinstall

LAP ASSIGNMENT SHEET #2

D. Below are listed five items to inspect during engine disassembly. Describe exactly what to look for during inspection of each part.

1. Cylinder head--Cracks
2. Valve train--Broken parts
3. Valves--Burned
4. Cylinder block water jacket--Sludge buildup
5. Cylinder block--Cracks

E. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your progress, continue to Learning Step 7. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to Learning Step 7.

State Department of Vocational and Technical Education CIMC Stillwater, Oklahoma LEARNING ACTIVITY PACKETS

for AUTO MECHANICS II

LAP NO. _____ CODE: _____

MAJOR INSTRUCTIONAL AREA SECTION A--ENGINE REBUILDING

INSTRUCTIONAL UNIT UNIT IV--VALVE TRAIN AND CYLINDER HEAD RECONDITIONING

LEARNING ACTIVITY PACKET NO.	PREREQUISITE LAP(S)
4	1

PURPOSE: This Learning Activity Packet (LAP) outlines the study activities and performance tasks for "Valve Train and Cylinder Head Reconditioning." Accomplishing these procedures will aid the student in attaining a working knowledge of this area of training and in achieving a SKILLED or MODERATELY SKILLED competency level in the performance of jobs associated with this specialty.

INTRODUCTION: The course of study in this LAP will help the student become able to describe the purpose and operation of the valve train assembly, identify reconditioning tools, and identify the parts of the valve train assembly. After completing this LAP, the student should be able to inspect timing gears, the timing chain, camshafts, and hydraulic lifters. The student will also be able to disassemble, clean, inspect, and recondition a cylinder head.

TASKS INCLUDED IN THIS LAP:

1. Inspect timing gears and measure timing chain for stretch and camshaft end play.
2. Inspect camshaft.
3. Clean and inspect hydraulic lifters.
4. Dissassemble, clean, and inspect a cylinder head assembly.
5. Recondition cylinder head.

SECTION A--ENGINE REBUILDING
UNIT IV--VALVE TRAIN AND CYLINDER HEAD RECONDITIONING

LEARNING STEPS

Check the following blanks as you complete the required steps.

_____ 1.	Read	Unit and Specific Objectives, pages AM II-97-A and 98-A.
_____ 2.	Complete	Valve Train and Cylinder Head Reconditioning Pretest, LAP page 9.
_____ 3.	Study	The sections of the Information Sheet (pages AM II-101-A through AM II-107-A) indicated by your instructor on your Pretest. Be sure to study the transparency masters when required.
_____ 4.	Refer	To Step 21 of the Pretest. If additional study is required for any of the Information Sheet, Sections I through XI, continue to Learning Step 5. Otherwise, proceed to Learning Step 7.
_____ 5.	Do	LAP Assignment Sheet #1, LAP page 25.
_____ 6.	Do	LAP Assignment Sheet #2, LAP page 33.
_____ 7.	Refer	To Step 21 of the Pretest. If additional study is required for any of the Information Sheet, Sections XII through XXII, continue to Learning Step 8. Otherwise, proceed to Learning Step 10.
_____ 8.	Do	LAP Assignment Sheet #3, LAP page 39.
_____ 9.	Do	LAP Assignment Sheet #4, LAP page 49.

_____10. Check — The tasks below which you feel that you can perform without supervision.

Student Check		Instructor Initials/Date Skilled	Moderately Skilled
_____	a. Inspect timing gears and measure timing chain for stretch and camshaft end play. (13)	_____	_____
_____	b. Inspect camshaft. (19)	_____	_____
_____	c. Clean and inspect hydraulic lifters. (25)	_____	_____
_____	d. Disassemble, clean, and inspect a cylinder head assembly. (31)	_____	_____
_____	e. Recondition cylinder head. (37)	_____	_____

_____11. Discuss — Your competency in each task with your instructor. Your instructor will initial each task in which you demonstrate sufficient competency. If all tasks have been initialed, proceed to Learning Step 43. Otherwise, continue to Learning Step 12.

_____12. Refer — To Learning Step 10a. If this task has been initialed, proceed to Learning Step 18. Otherwise, continue to Learning Step 13.

_____13. Study — Job Sheet #1--Inspect Timing Gears and Measure Timing Chain for Stretch and Camshaft End Play, pages AM II-139-A and 140-A.

_____14. Watch — Slide/tape presentation, "Inspect Timing Gears and Measure Timing Chain for Stretch and Camshaft End Play" (A-IV-1).

LEARNING STEPS

_____15.	Do	Job Sheet #1--Inspect Timing Gears and Measure Timing Chain for Stretch and Camshaft End Play.
_____16.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 10a and continue to Learning Step 17. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor intital Learning Step 10a and continue to Learning Step 17.
_____17.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 10a and continue to Learning Step 18. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 10a and continue to Learning Step 18.
_____18.	Refer	To Learning Step 10b. If this task has been initialed, proceed to Learning Step 24. Otherwise, continue to Learning Step 19.
_____19.	Study	Job Sheet #2--Inspect Camshaft, pages AM II-41-A through AM II-45-A.
_____20.	Watch	Slide/tape presentation, "Inspect Camshaft" (A-IV-2).
_____21.	Do	Job Sheet #2--Inspect Camshaft.
_____22.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 10b and continue to Learning Step 24. Otherwise, repeat Learning Steps 19 through 21 and then continue to Learning Step 23.

_____23.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 10b and continue to Learning Step 24. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 10b and continue to Learning Step 24.
_____24.	Refer	To Learning Step 10c. If this task has been initialed, proceed to Learning Step 30. Otherwise, continue to Learning Step 25.
_____25.	Study	Job Sheet #3--Clean and Inspect Hydraulic Lifters, pages AM II-147-A through 150-A.
_____26.	Watch	Slide/tape presentation "Clean and Inspect Hydraulic Lifters" (A-IV-3).
_____27.	Do	Job Sheet #3--Clean and Inspect Hydraulic Lifters.
_____28.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 10c and proceed to Learning Step 30. Otherwise, repeat Learning Steps 25 through 27 and then continue to Learning Step 29.
_____29.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 10c and continue to Learning Step 30. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 10c and continue to Learning Step 30.

LEARNING STEPS

_____30.	Refer	To Learning Step 10d. If this task has been initialed, proceed to Learning Step 36. Otherwise, continue to Learning Step 31.
_____31.	Study	Job Sheet #4--Disassemble, Clean, and Inspect a Cylinder Head Assembly, pages AM II-151-A through AM II-157-A.
_____32.	Watch	Slide/tape presentation "Disassemble, Clean, and Inspect a Cylinder Head Assembly" (A-IV-4).
_____33.	Do	Job Sheet #4--Disassemble, Clean, and Inspect a Cylinder Head Assembly.
_____34.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 10d and proceed to Learning Step 36. Otherwise, repeat Learning Steps 31 through 33 and then continue to Learning Step 35.
_____35.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 10d and continue to Learning Step 36. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 10d and continue to Learning Step 36.
_____36.	Refer	To Learning Step 10e. If this task has been initialed, proceed to Learning Step 42. Otherwise, continue to Learning Step 37.
_____37.	Study	Job Sheet #5--Recondition Cylinder Head, pages AM II-159-A through 168-A.

_____38.	Watch	Slide/tape presentation, "Recondition a Cylinder Head" (A-IV-5).
_____39.	Do	Job Sheet #5--Recondition Cylinder Head.
_____40.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 10e and proceed to Learning Step 42. Otherwise, repeat Learning Steps 37 through 39 and then continue to Learning Step 41.
_____41.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 10e and continue to Learning Step 42. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 10e and continue to Learning Step 42.
_____42.	Refer	To Learning Step 10. If all tasks have been initialed, continue to Learning Step 43. Otherwise, refer to the step indicated in parentheses after the unsigned task.
_____43.	Review	Information Sheets (pages AM II-101-A through AM II-107-A) and LAP Assignment Sheets.
_____44.	Take	Valve Train and Cylinder Head Reconditioning Test (see your instructor). If your score is 85 percent or above, continue to the next assigned Learning Activity Packet. Otherwise, ask your instructor about additional study requirements and possible retesting.

SECTION A--ENGINE REBUILDING
UNIT IV--VALVE TRAIN AND CYLINDER HEAD RECONDITIONING

PRETEST

NAME_____ SCORE_____

DIRECTIONS: This pretest is to determine how much you already know about the valve train and cylinder head reconditioning. Your performance on this pretest will not be used to determine your grade in the course. Instead, it will guide your instructor in designing this course to meet your needs. If you are unsure of the answer to a question, do not guess. Guessing may prevent you from receiving needed instruction.

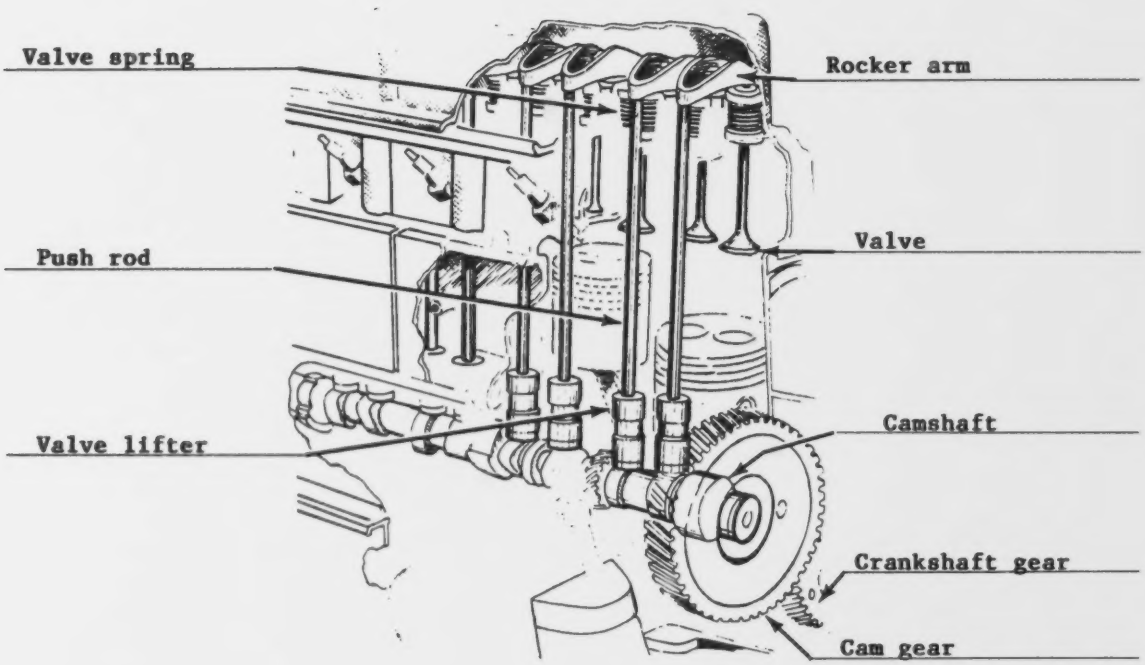
1. Match the following terms and definitions. Write the correct numbers in the blanks.

1	a. Looseness necessary for proper valve seating	1. Valve lash or clearance adjustment
3	b. Camshaft located in cylinder head(s)	2. Valve lifter
6	c. Cylindrical part that rests on cam	3. I-head engine
9	d. Distance valve moves from full open to full close	4. Cylinder head
4	e. Valve-operating mechanism	5. Cam lift
2	f. Engine with valves located in the cylinder head over the cylinder	6. Overhead camshaft
7	g. Shaft that operates valves through a series of lobes	7. Camshaft
5	h. Degrees of crankshaft rotation while valves are open	8. Valve train
8	i. Encloses cylinder bores and water jacket	9. Cam duration

2. Explain the purpose of the valve train.

Operates and coordinates intake and exhaust valves with movement of the pistons; creates four-stroke cycle.

3. Identify the parts of the valve train in the illustration below. Write the correct names of the parts in the blanks.



4. Describe the functions of the following valve train components.

   a. Valve-- **Opens and closes intake and exhaust ports**

   b. Valve spring-- **Closes valve**

   c. Rocker arm-- **Changes direction of valve train motion; pushes valve off its seat**

   d. Push rod-- **Transmits motion from lifter to rocker arm**

   e. Lifter (tappet)-- **Rides on cam lobes; changes rotation to reciprocation**

   f. Camshaft-- **Operates the valve lifters**

   g. Cam gear-- **Turns the camshaft; times camshaft with crankshaft**

   h. Crankshaft gear-- **Drives cam gear**

5. List the two common camshaft locations.

   a. **Cylinder head**

   b. **Cylinder block**

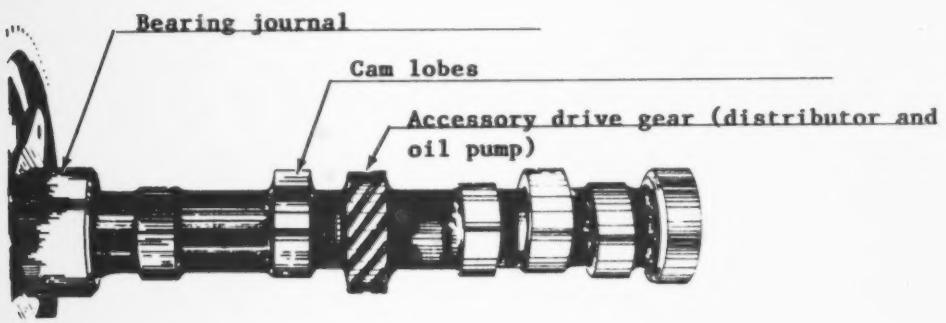
6. What methods are commonly used to drive the camshaft?

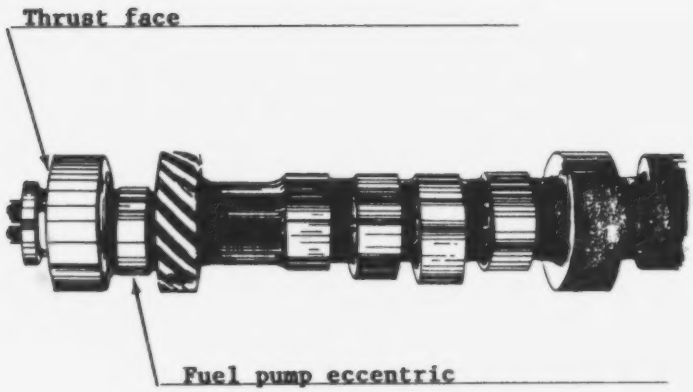
   a. **Chain**

   b. **Belt**

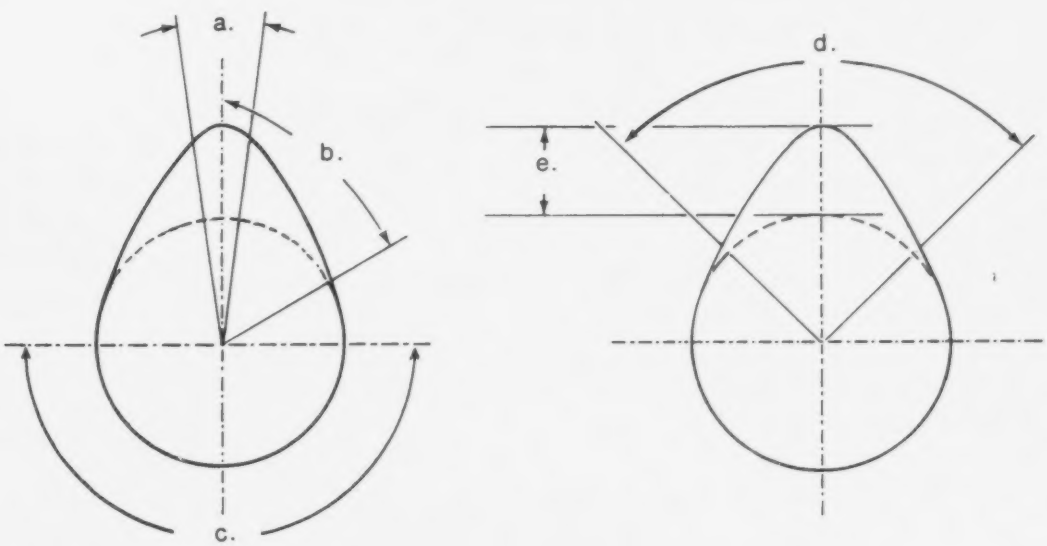
   c. **Gear**

7. Identify the parts of the camshaft in the following illustrations. Write the names of the parts in the blanks.





8. Identify the parts of the cam lobe. Write the correct names of the parts in the blanks corresponding to the letters in the illustrations.



a. Nose

b. Ramp

c. Heel

d. Amount of valve lift

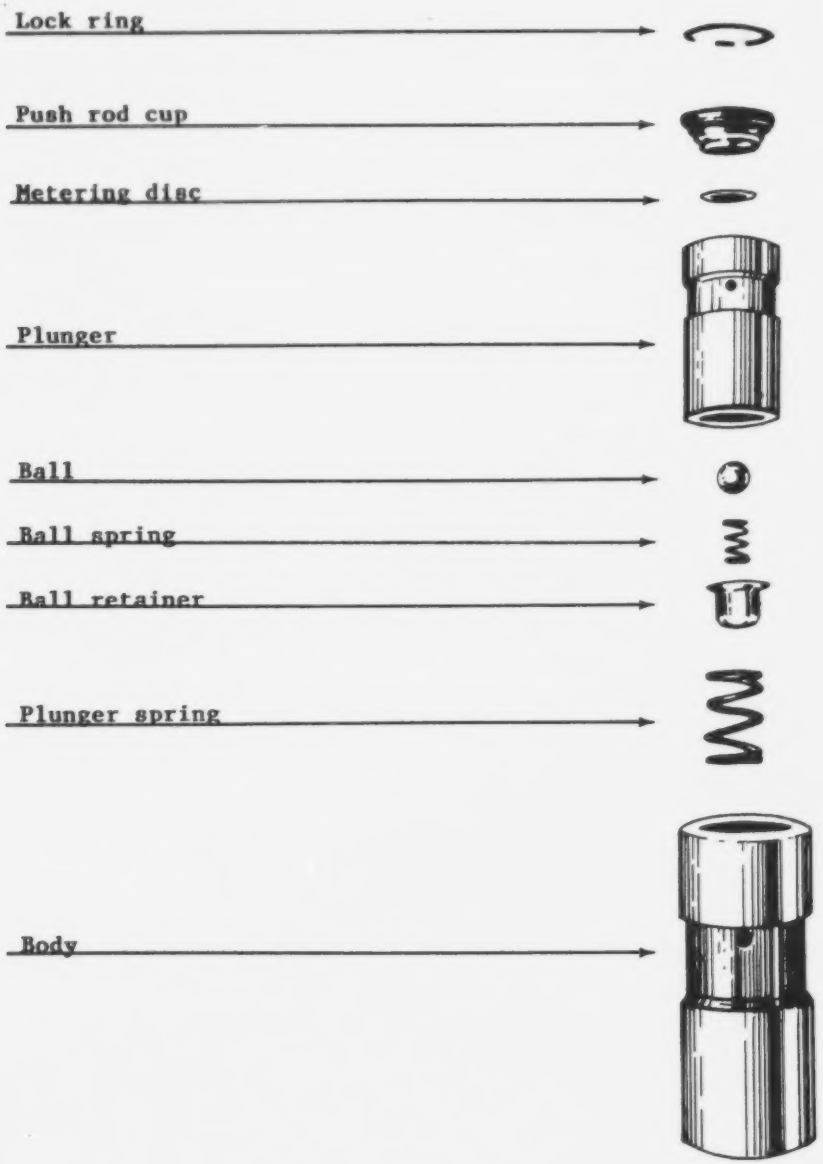
e. Valve duration in degrees

9. What are two types of valve lifters?

   a. **Solid**

   b. **Hydraulic**

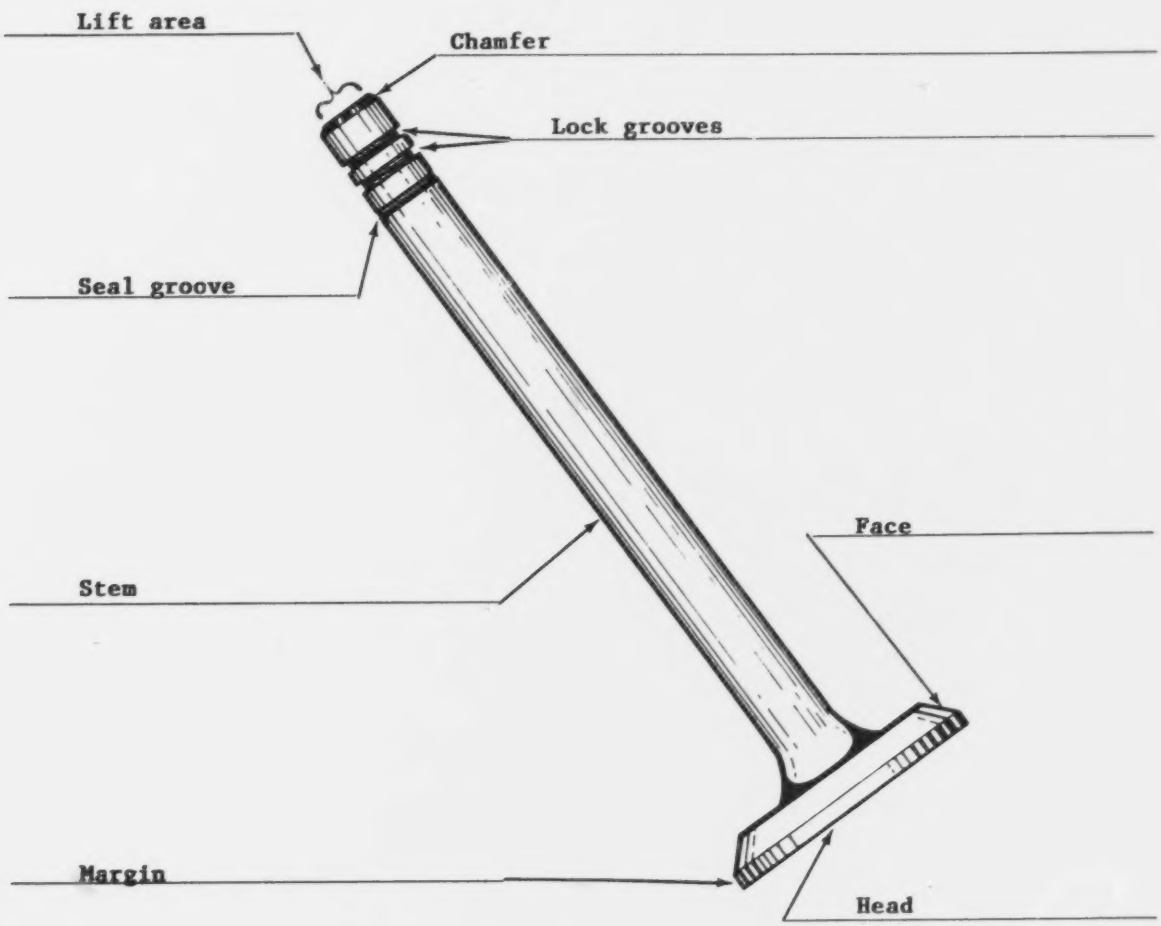
10. Identify the parts of the hydraulic valve lifter in the illustration below. Write the names of the parts in the correct blanks.



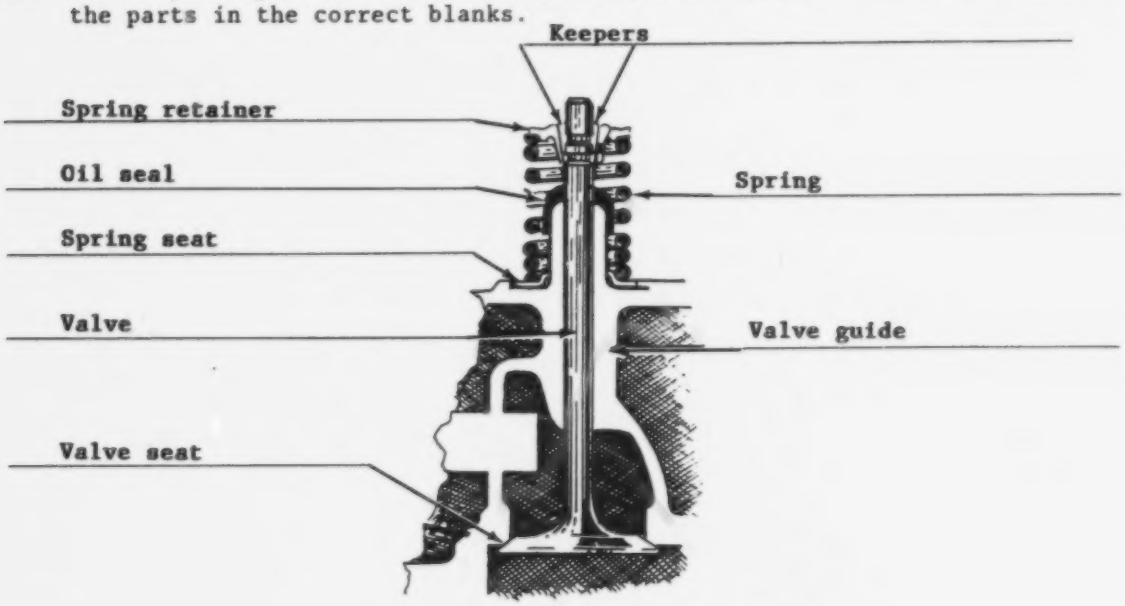
11. Describe the operation of a hydraulic valve lifter.

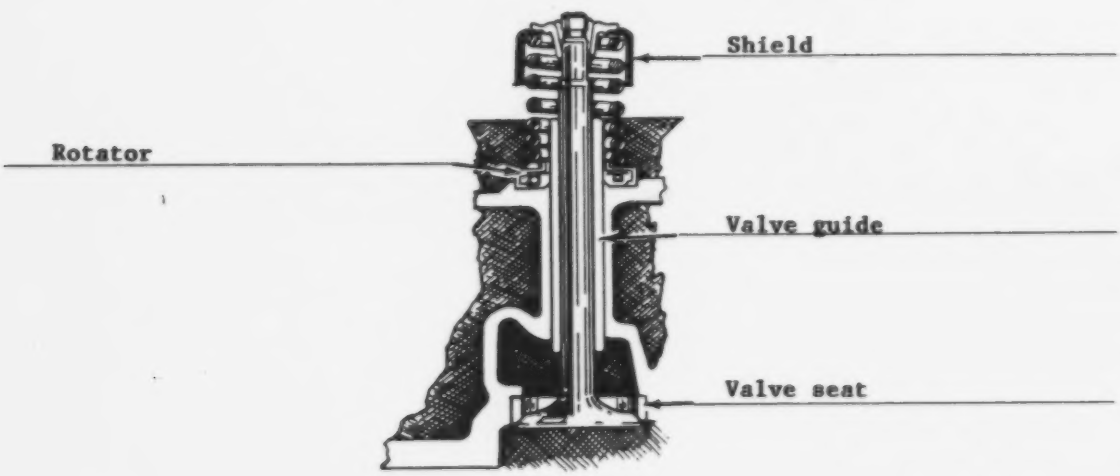
Engine oil is fed into lifter through holes in lifter body. Oil inside plunger pushes check valve open, filling area between bottom of plunger and body and causing expansion and zero clearance in valve linkage while lifter is on heel of cam lobe. Trapped oil maintains plunger position in lifter body as lifter rides up cam lobe.

12. Identify the parts of a valve in the drawing below. Write the name of each part in the correct blank.



13. Identify the parts of the valve assembly shown below. Write the names of the parts in the correct blanks.



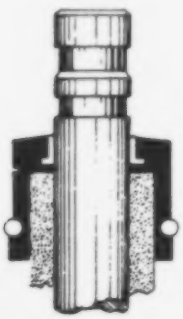


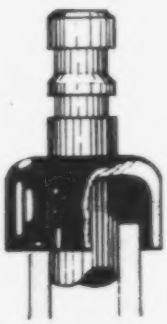
14. Identify the following types of valve springs and stem seals. Write the correct names in the blanks below the illustrations.

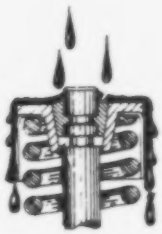
a. Friction damper b. Standard c. Friction damper tube

d. Variable rate e. Standard with inner assist

15. Write the correct names in the blanks below the following illustrations of types of valve stem seals.



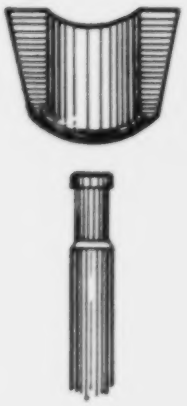




a. Teflon cup b. Cup or umbrella c. O-ring

16. Identify the following types of valve spring keepers. Write the correct names in the blanks below the illustrations.

a. Four-groove conical



b. Plain conical

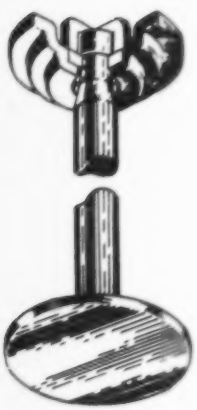
c. Horseshoe

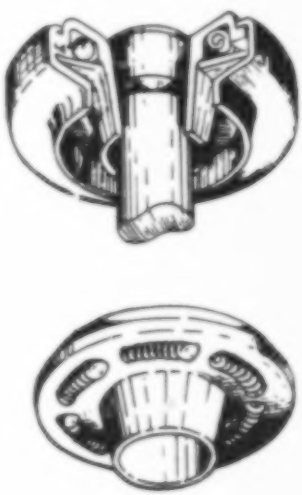
d. Single-groove conical

e. Pin type f. Two-groove conical

17. What is the purpose of the valve spring spacer? Maintains correct valve spring height after the valve assembly is installed.

18. Write the names of the following types of valve rotators in the blanks below the illustrations.





a. Free b. Off-center c. Positive

19. Explain the purpose of a valve rotator.

Turns the valve slightly each time the valve opens

20. Give two reasons why a valve must seat properly.

a. To seal combustion chamber

b. To cool the valve

21. Give ten major causes of valve burning.

ANSWER SHOULD INCLUDE ANY TEN OF THE FOLLOWING.

a. Weak or cocked valve springs

b. Insufficient valve tappet clearance

c. Improper valve seating

d. Worn valve guides

e. Clogged water jacket or distribution tube

f. Engine overheating

g. Carbon deposits in combustion chamber

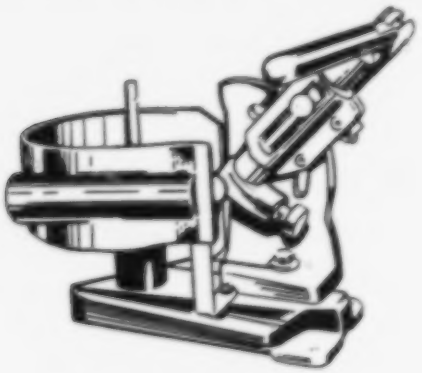
h. Exhaust heat riser valve stuck closed

i. Warped valve seat

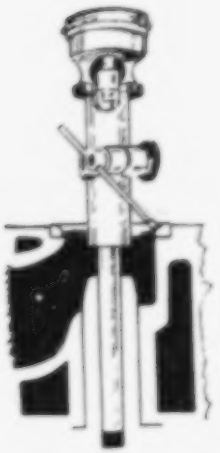
j. Lean air-fuel misture

k. Preignition or detonation

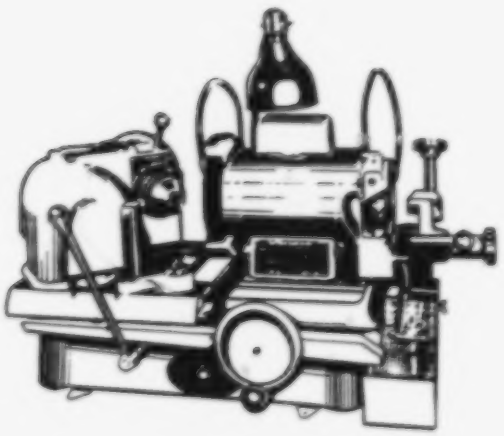
22. Identify the following valve reconditioning tools. Write the names of the tools in the blanks below the illustrations.



a. Wheel dressing tool

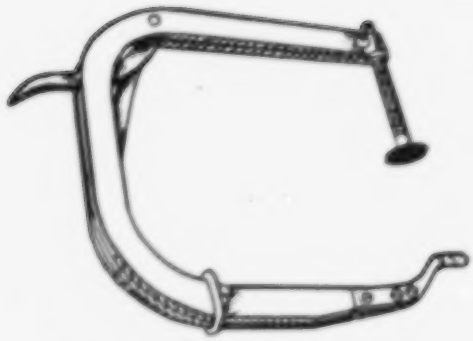


b. Valve seat indicator

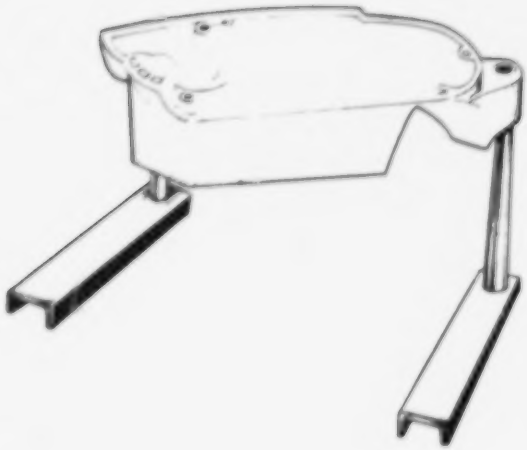


c. Valve grinding machine

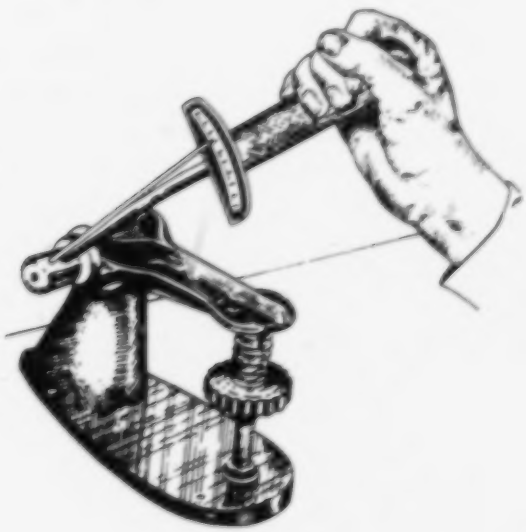
d. Drive motor for seat grinding



e. Spring compressor



f. Cylinder head stand



g. Valve spring tension gauge

h. Wheel holder

i. Guide cleaner j. Seat grinding pilot k. Guide reamer

l. Carbon scraper m. Carbon brush

23. Stop. Have your instructor evaluate your pretest and mark the area(s) below requiring additional study.

Refer to Information Sheet, Section(s)

____ I	____ IX	____ XVII
____ II	____ X	____ XVIII
____ III	____ XI	____ XIX
____ IV	____ XII	____ XX
____ V	____ XIII	____ XXI
____ VI	____ XIV	____ XXII
____ VII	____ XV	
____ VIII	____ XVI	

You came here from Learning Step 2. If none of the above study sections are checked, proceed to Learning Step 10. Otherwise, continue to Learning Step 3.

SECTION A--ENGINE REBUILDING
UNIT IV--VALVE TRAIN AND CYLINDER HEAD RECONDITIONING

LAP ASSIGNMENT SHEET #1

NAME_____ SCORE_____

A. Match the terms and definitions listed below. Write the correct letters in the blanks.

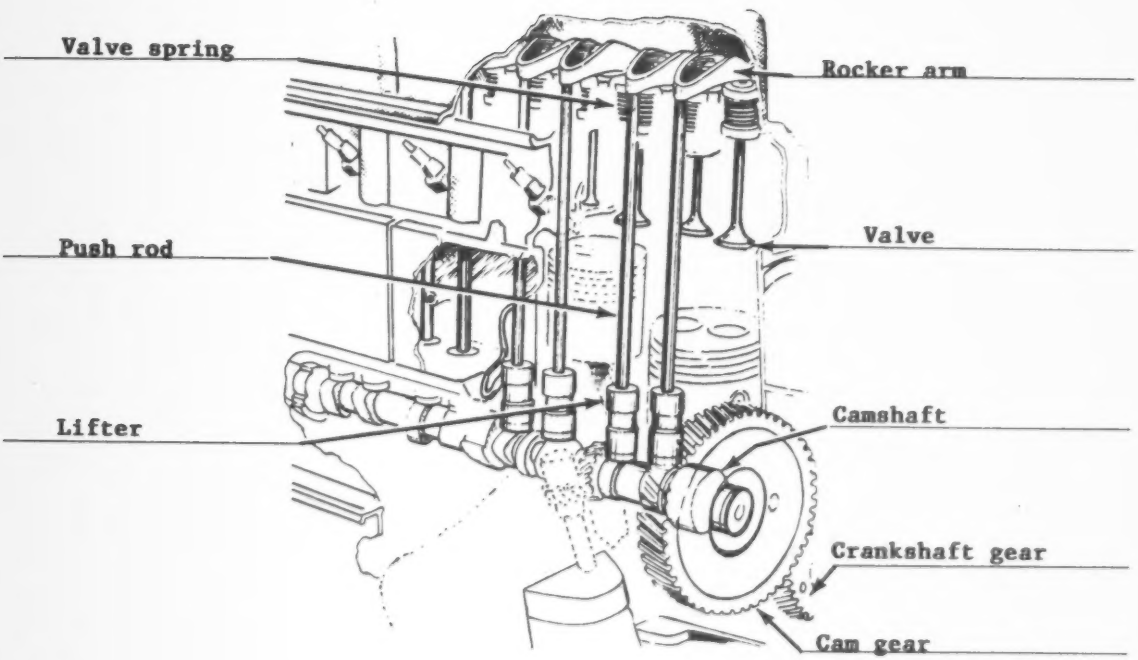
i	1. Shaft that operates the valves through a series of lobes	a. Valve lash or clearance adjustment
b	2. Number of degrees crankshaft rotates while valves are open	b. Cam duration
e	3. Distance valve moves from full open to completely closed	c. Overhead camshaft
d	4. Valve operating mechanism in the engine	d. Valve train
c	5. Camshaft located in cylinder head	e. Cam lift
g	6. Encloses cylinder bores and contains water jacket; sometimes contains the valves	f. Valve lifter
h	7. Cylindrical part; rests on cam	g. I-head engine
f	8. Engine with valves in the cylinder head over the cylinder	h. Cylinder head
a	9. Valve looseness necessary for proper seating	i. Camshaft

B. What is the purpose of the valve train?

To operate the valves with piston movement which will cause the four-stroke cycle to occur.

LAP ASSIGNMENT SHEET #1

C. Identify the parts of the valve train illustrated below. Write the names of the parts in the correct blanks.



D. Match the following valve train parts and their functions. Write the correct letter in the blanks.

c	1. Drives cam gear	a.	Camshaft
d	2. Turns camshaft	b.	Valve
b	3. Operates the valve lifters	c.	Cam gear
a	4. Opens and closes intake and exhaust ports	d.	Crankshaft gear
e	5. Forces valve to close	e.	Valve spring
h	6. Transmits motion from lifter to rocker arm	f.	Rocker arm
f	7. Rides along cam lobe	g.	Push rod
g	8. Pushes valve off its seat	h.	Lifter (tappet)

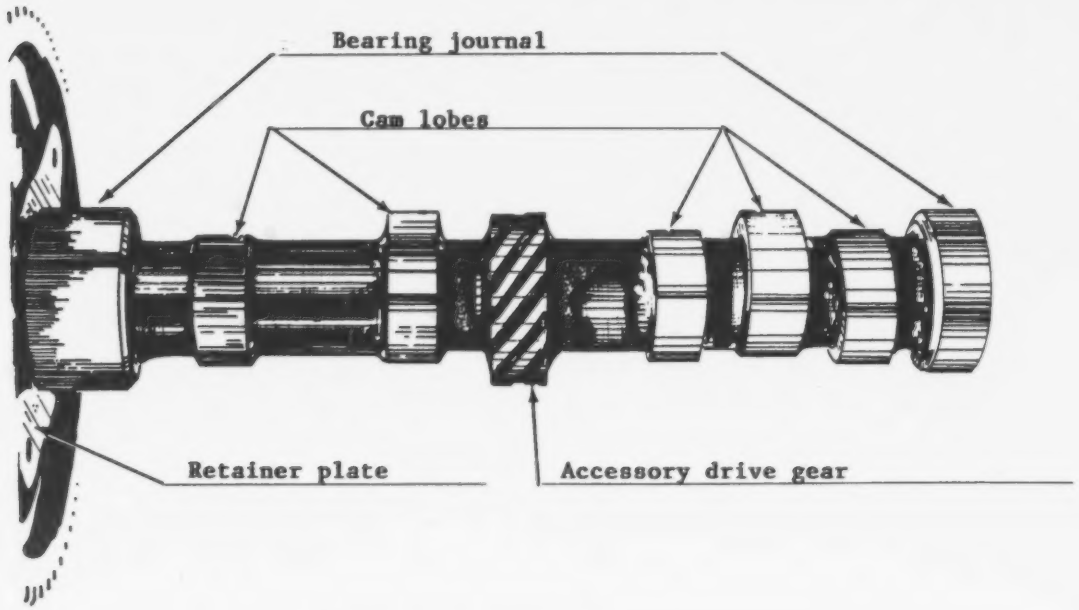
E. What are the two camshaft locations?

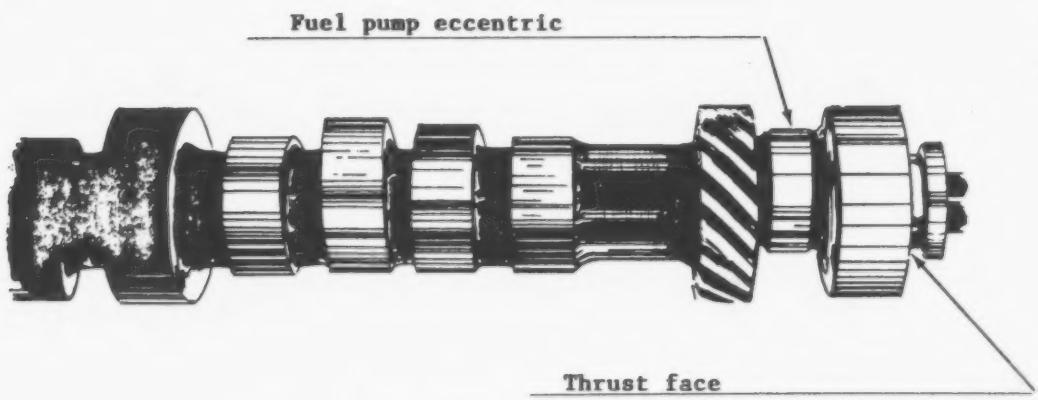
1. **Cylinder block**
2. **Cylinder head**

F. What are the three methods of driving the camshaft?

1. **Gear**
2. **Belt**
3. **Chain**

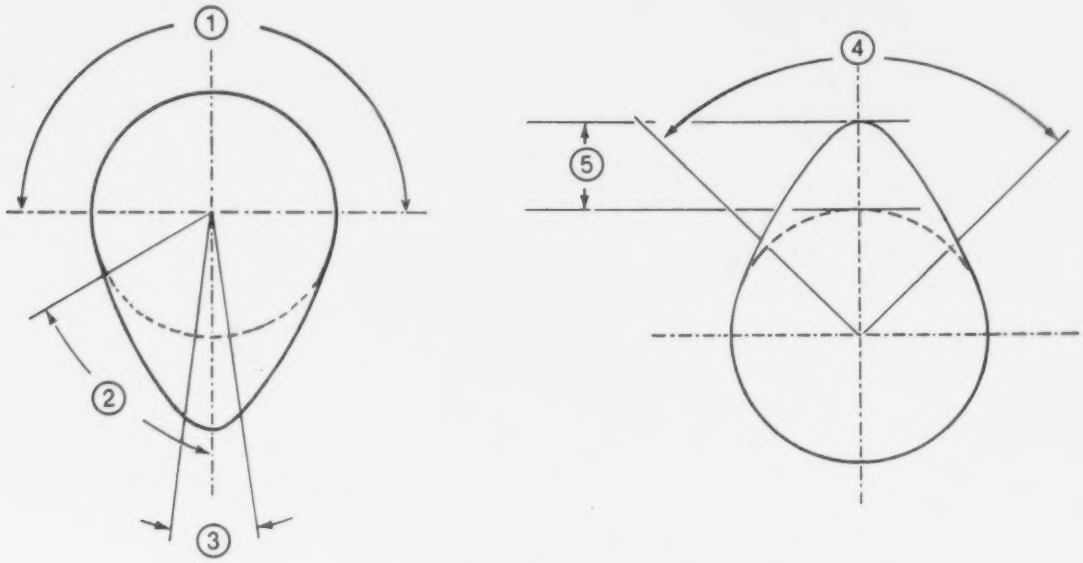
G. Identify the parts of the camshafts shown below. Write the correct names of the parts in the blanks.





LAP ASSIGNMENT SHEET #1

H. Identify the parts of the cam lobe. Write the correct names of the parts in the blanks corresponding to the numbers in the illustrations.



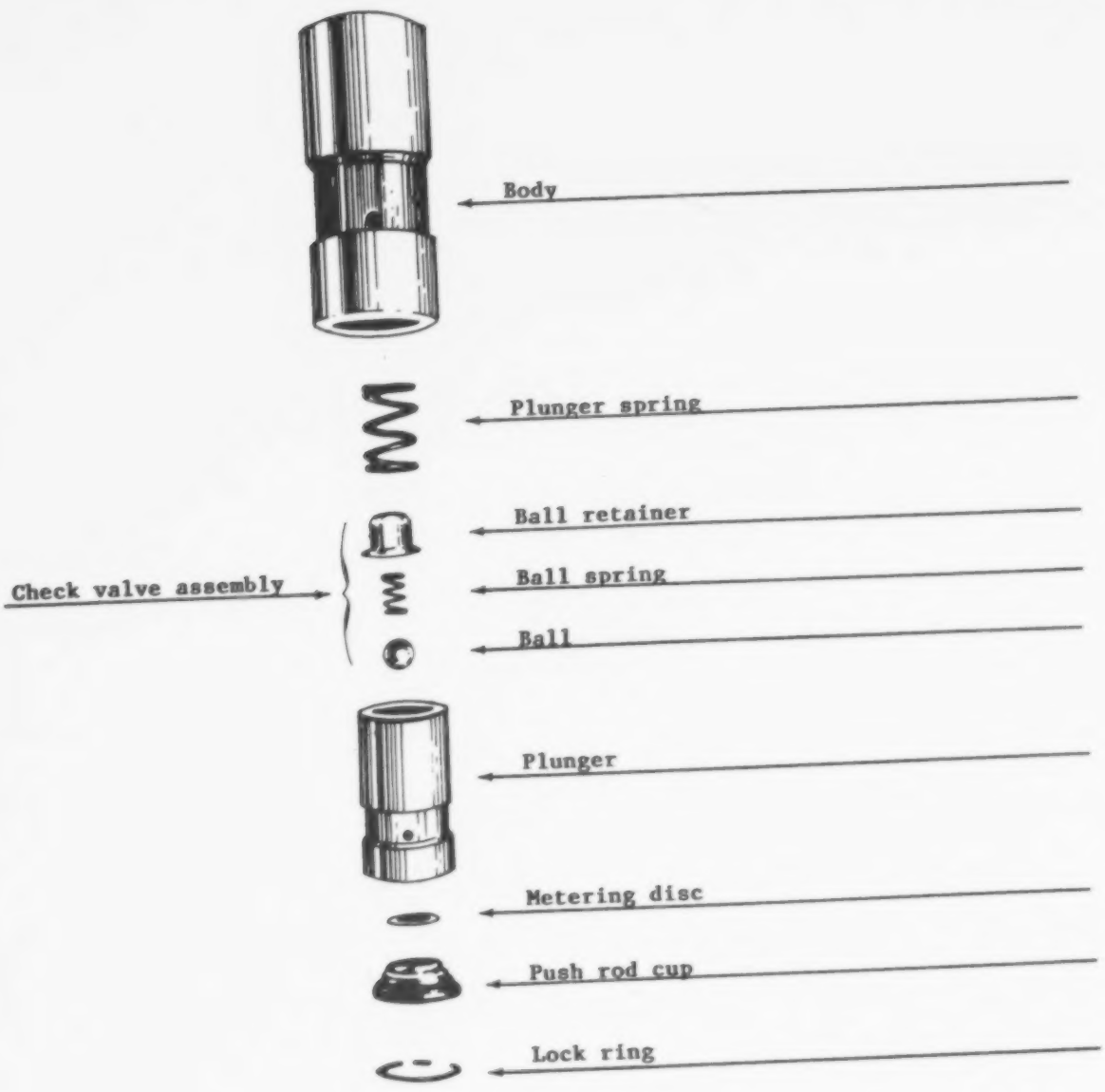
1. **Heel**
2. **Ramp**
3. **Nose**
4. **Valve duration**
5. **Amount of valve lift**

I. What are the two types of valve lifters?

1. **Solid**
2. **Hydraulic**

LAP ASSIGNMENT SHEET #1

J. Identify the parts of the hydraulic valve lifter in the illustration below. Write the names of the parts in the blanks.



K. Describe the operation of a hydraulic valve lifter.

Engine oil enters lifter body through holes in the undercut area. Oil forces plunger to expand. Plunger extends to take up all valve lash. Check valve closes and maintains plunger position.

L. Stop. Have your instructor evaluate your assignment sheet and mark the area(s) below requiring additional study.

Refer to Information Sheet, Section(s)

___ I	___ V	___ IX
___ II	___ VI	___ X
___ III	___ VII	___ XI
___ IV	___ VIII	

If none of the above sections are checked, proceed to Learning Step 7. Otherwise, study the required section(s) and then continue to Learning Step 6.

SECTION A--ENGINE REBUILDING
UNIT IV--VALVE TRAIN AND CYLINDER HEAD RECONDITIONING

LAP ASSIGNMENT SHEET #2

NAME_____ SCORE_____

A. Fill in the missing word in each of the sentences below.

1. The lobed shaft which operates the valves is called the **camshaft**.
2. **Cam** **duration** is the number of crankshaft degrees the valve is actually open.
3. The valve **lifter** is a cylindrical part which rests on the cam lobe.
4. The **I-head** type engine has its valves located in the cylinder head.
5. Valve **lash** is the clearance necessary for proper valve seating.
6. Cam lift is the **distance** the valve moves from full open to completely closed.
7. The **cylinder** **head** encloses the cylinder bores and contains the water jacket.
8. The **valve** **train** is the actual valve operating mechanism of the engine.
9. In an engine with an **overhead** camshaft, the camshaft is located in the cylinder head.

LAP ASSIGNMENT SHEET #2

B. Match the names of parts of the valve train and their correct locations in the illustration below. Write the correct numbers in the blanks.

__2__ Push rod

__1__ Valve spring

__3__ Lifter

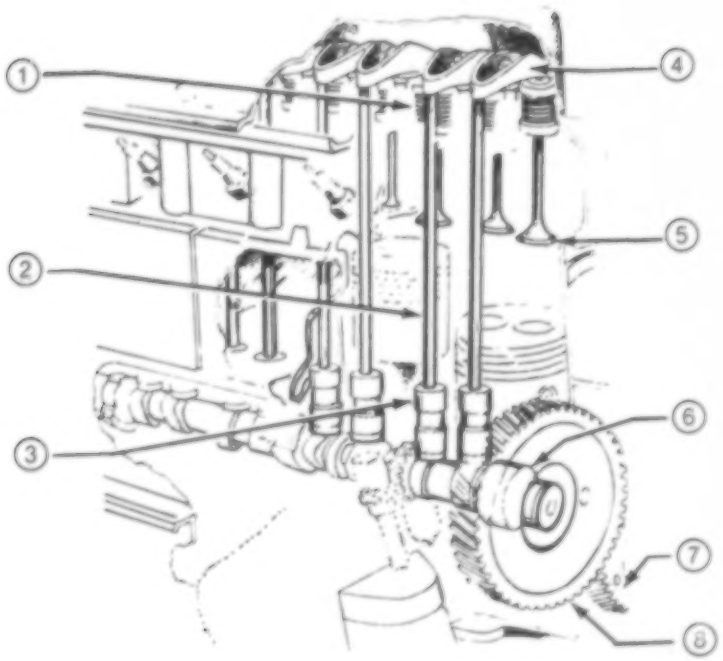
__4__ Rocker arm

__5__ Valve

__6__ Camshaft

__8__ Cam gear

__7__ Crankshaft gear



LAP ASSIGNMENT SHEET #2

C. Fill in the missing words in the following statements about functions of parts of the valve train.

1. The crankshaft gear drives the cam gear which turns the camshaft.

2. The lifter is a cylindrical part which rides on the cam lobe.

3. The push rod transmits motion from the lifter to the rocker arm.

4. The rocker arm forces the valve to open and the valve spring closes it.

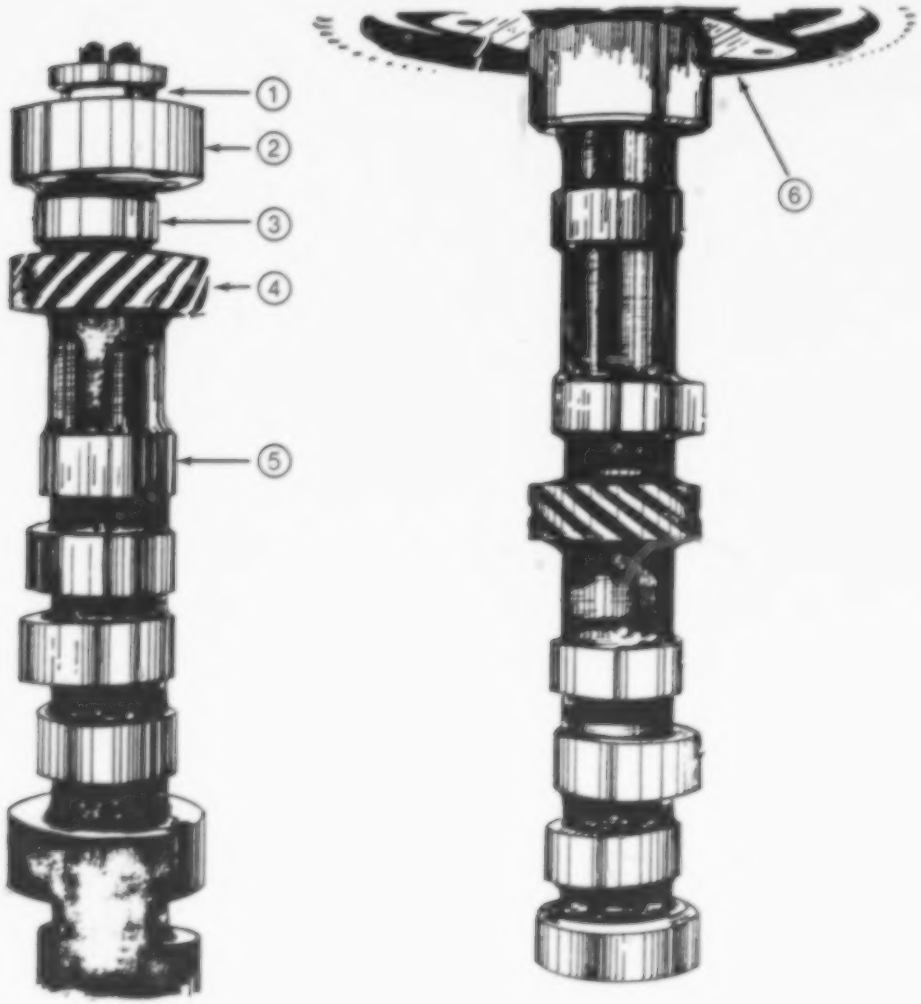
5. The camshaft is located either in the cylinder head or the cylinder block.

6. There are three ways to drive a camshaft. They are either belt, gear, or chain driven.

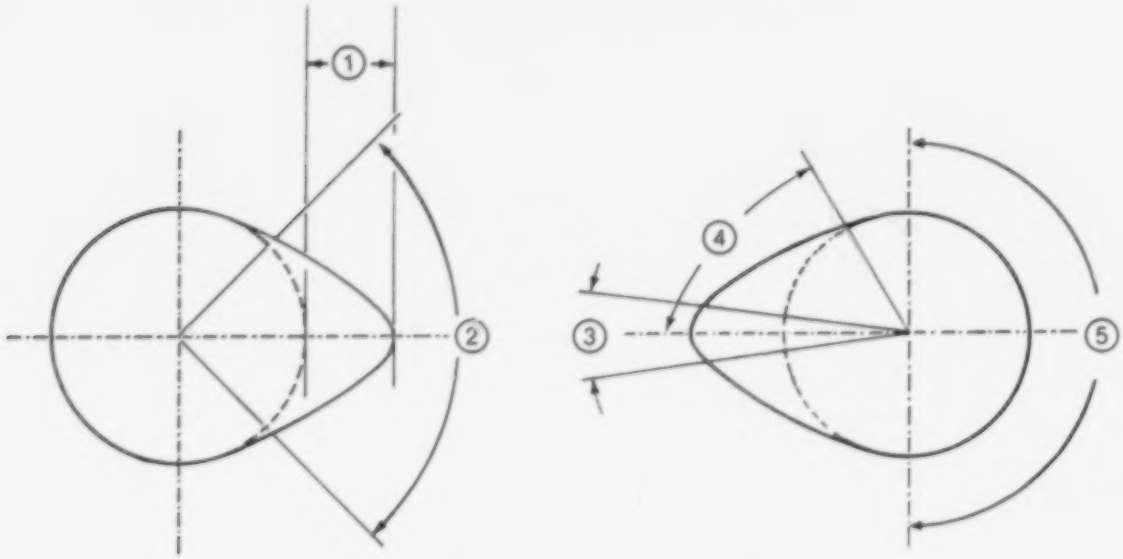
LAP ASSIGNMENT SHEET #2

D. Match the names of the parts listed below and their correct locations on the camshafts illustrated. Write the correct numbers in the blanks

3 Fuel pump eccentric	6 Retainer plate
5 Cam lobes	2 Bearing journal
4 Accessory drive gear	1 Thrust face



E. Match the terms listed below the illustrations and the numbered sections of the cam lobes. Write the correct numbers in the blanks.



__3__ Nose

__1__ Amount of valve lift

__5__ Heel

__4__ Ramp

__2__ Valve duration

F. Fill in the missing words in the statement below.

There are two types of valve lifters: __solid__ and __hydraulic__.

LAP ASSIGNMENT SHEET #2

G. Match the names of the parts listed below and their locations on the hydraulic valve lifter illustrated. Write the correct numbers in the blanks.

__1__ Lock ring

__3__ Metering disc

__7__ Ball retainer

__9__ Body

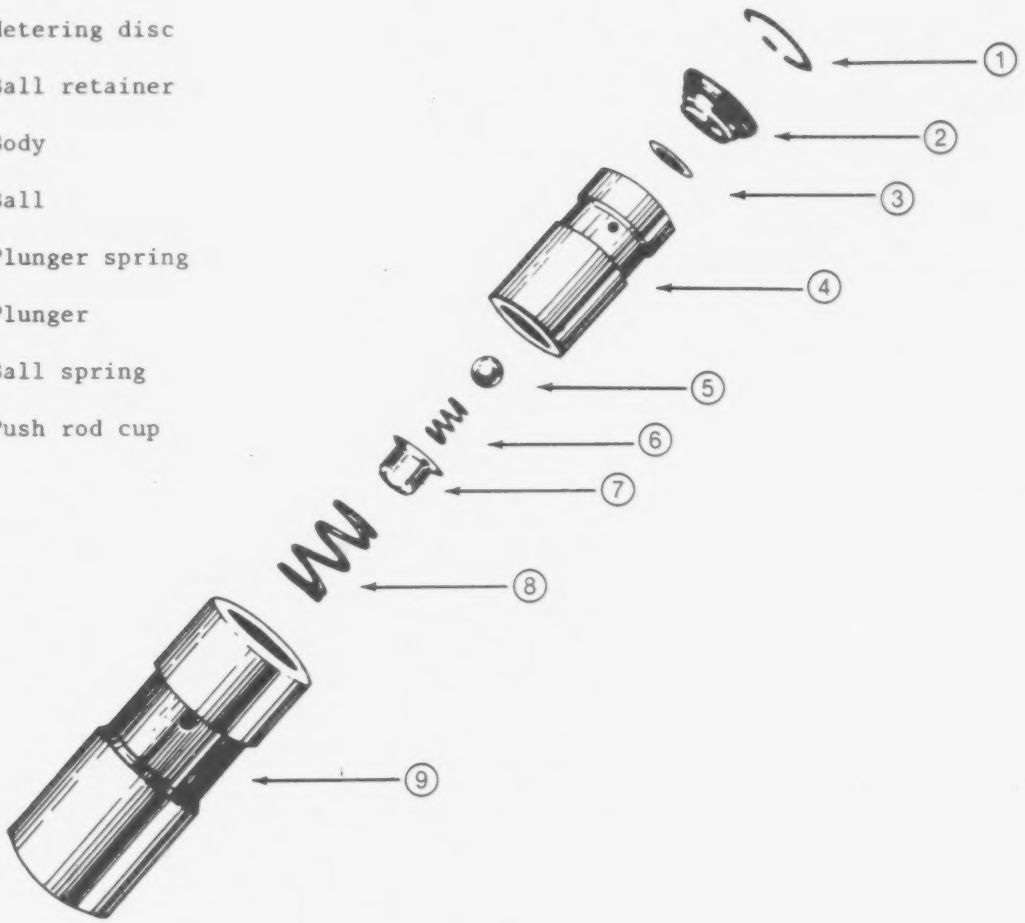
__5__ Ball

__8__ Plunger spring

__4__ Plunger

__6__ Ball spring

__2__ Push rod cup



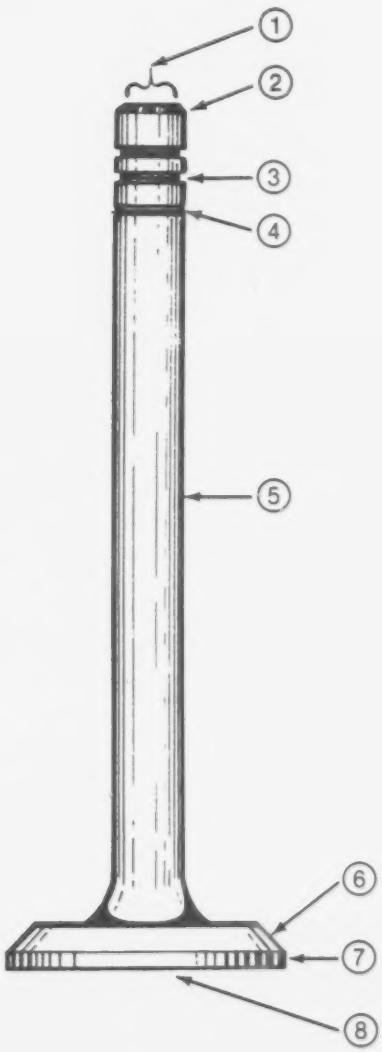
H. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your progress continue to Learning Step 7. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to Learning Step 7.

SECTION A--ENGINE REBUILDING
UNIT IV--VALVE TRAIN AND CYLINDER HEAD RECONDITIONING

LAP ASSIGNMENT SHEET #3

NAME_____ SCORE_____

A. Match the names and locations of parts of the valve in the illustration below. Write the correct numbers in the blanks before the names of the parts.



__5__ Stem

__4__ Seal groove

__6__ Face

__8__ Head

__3__ Lock groove

__2__ Chamfer

__7__ Margin

__1__ Lift area

LAP ASSIGNMENT SHEET #3

B. Match the names and locations of the parts of the valve assemblies illustrated. Write the correct numbers in the blanks.

__4__ Valve seat

__10__ Rotator

__2__ Spring

__9__ Shield

__3__ Valve guide (replaceable)

__1__ Keepers

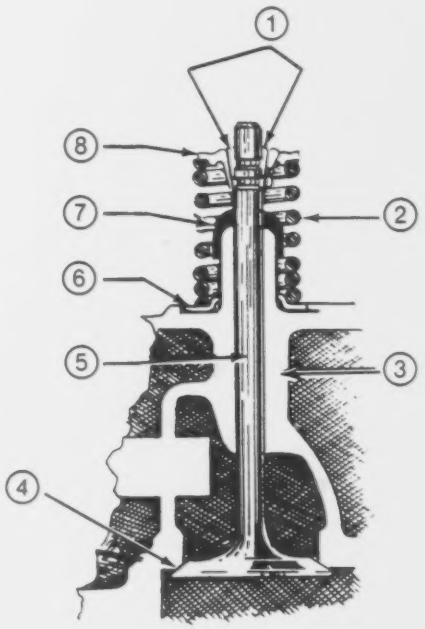
__8__ Spring retainer

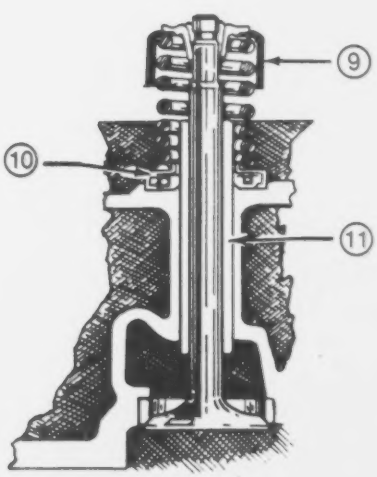
__7__ Oil seal

__5__ Valve

__6__ Spring seat

__11__ Valve guide (integral)





LAP ASSIGNMENT SHEET #3

C. Match illustrations of valve springs and their names. Write the numbers in the blanks before the correct names of the valve springs.

__4__ Standard spring

__5__ Standard spring with internal assist

__3__ Variable rate spring

__2__ Friction damper spring

__1__ Friction damper tube

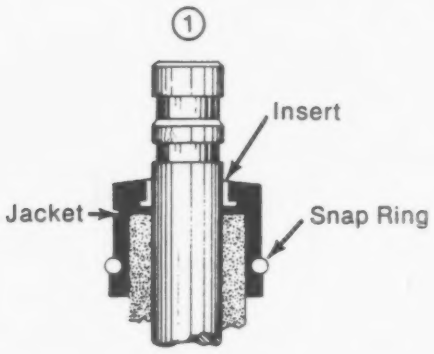
LAP ASSIGNMENT SHEET #3

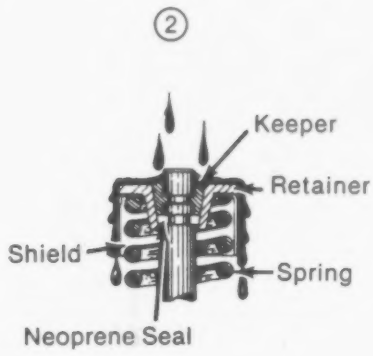
D. Match the names and illustrations of types of valve stem seals. Write the correct numbers in the blanks.

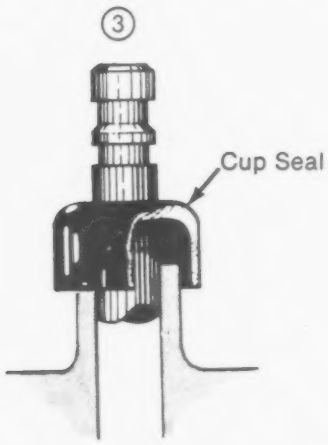
__1__ Teflon cup

__2__ O-ring

__3__ Umbrella







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LAP ASSIGNMENT SHEET #3

E. Match illustrations of types of valve spring keepers and their names. Write the numbers of the illustrations in the blanks before their correct names.

__6__ Pin type

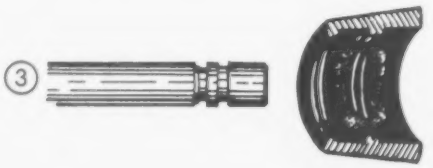
__4__ Four-groove conical

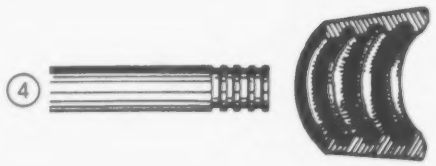
__5__ Horseshoe

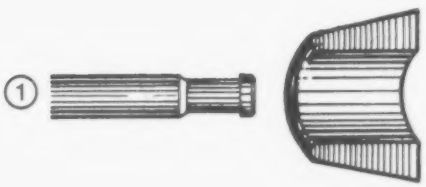
__1__ Plain conical

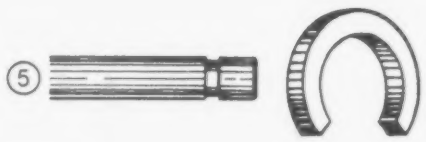
__2__ Single-groove conical

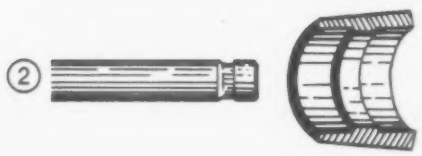
__3__ Two-groove conical











F. Fill in the missing words in the statement below.

The valve spring spacer's purpose is to maintain correct valve

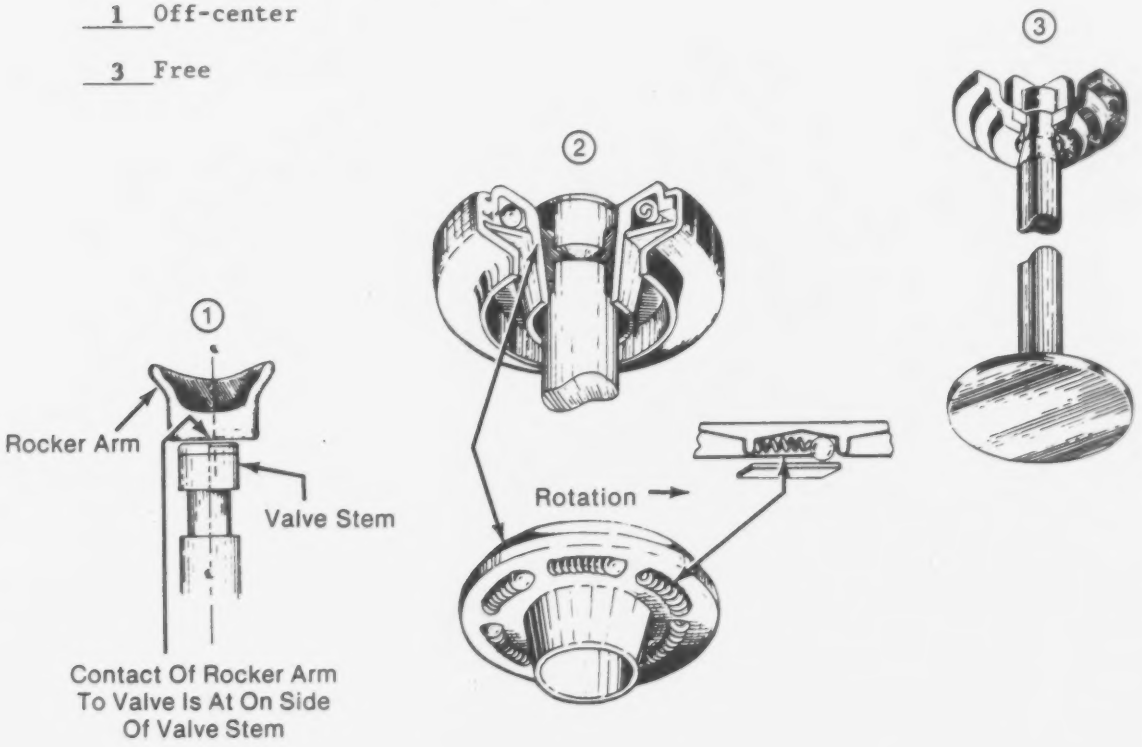
__spring__ installed __height__.

G. Match the names of the valve rotators and their illustrations shown below. Write the correct numbers in the blanks.

__2__ Positive

__1__ Off-center

__3__ Free



LAP ASSIGNMENT SHEET #3

H. Complete the statement below by filling in the missing words.

The valve rotator is designed to rotate the valve each time it opens. This rotation provides a wiping motion and helps prevent carbon buildup.

I. Give two reasons why a valve must seat properly.

1. To seal the combustion chamber
2. To cool the valve

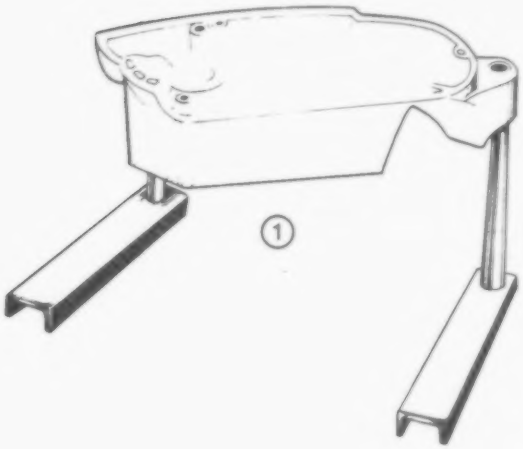
J. Give ten causes of valve burning.

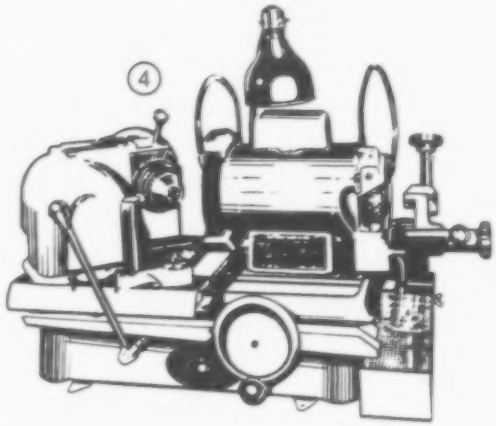
ANSWER SHOULD INCLUDE ANY TEN OF THE FOLLOWING.

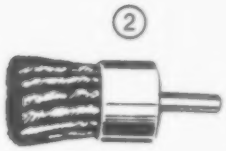
1. Improper valve seat
2. Exhaust heat riser valve stuck closed
3. Clogged water jacket or distribution tube
4. Warped valve seat
5. Weak or cocked valve springs
6. Insufficient valve clearance
7. Engine overheating
8. Lean air-fuel mixture
9. Preignition or detonation
10. Worn valve guides
11. Carbon deposits in combustion chamber

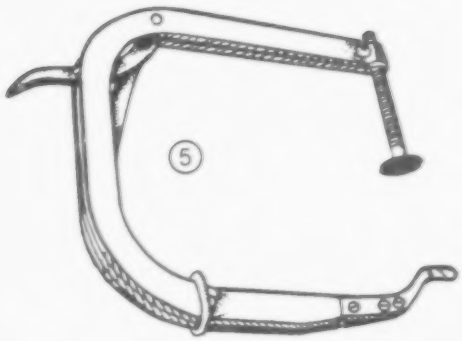
LAP ASSIGNMENT SHEET #3

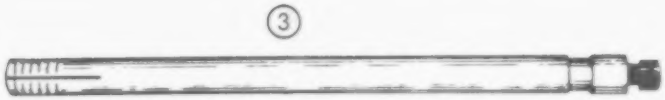
K. Identify the following valve reconditioning tools. Write the correct names in the blanks corresponding to the numbers of the illustrations.











1. Cylinder head stand
2. Carbon brush
3. Seat grinding pilot
4. Valve grinding machine
5. Valve spring compressor

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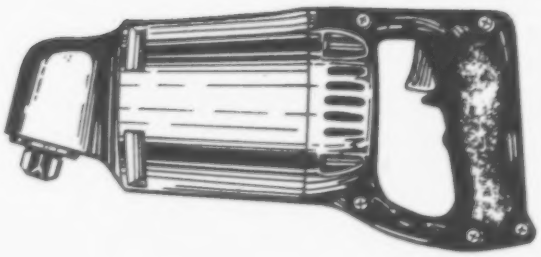
LAP ASSIGNMENT SHEET #3

⑥



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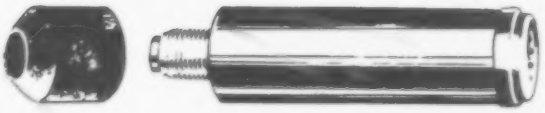
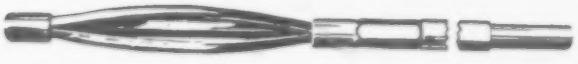
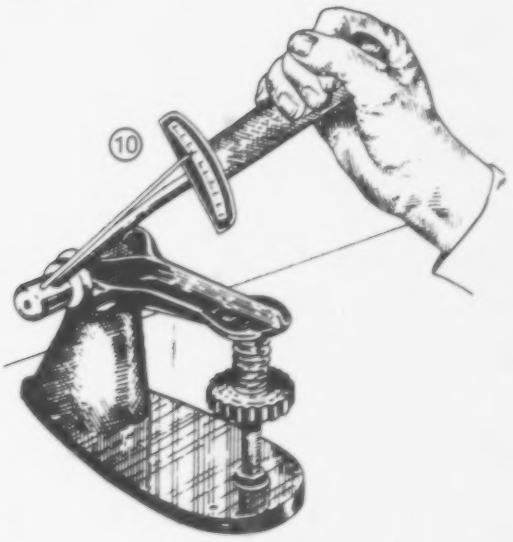


⑧

⑨





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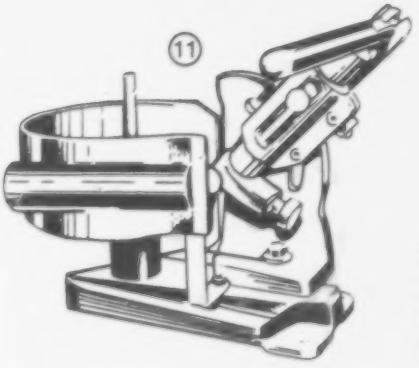

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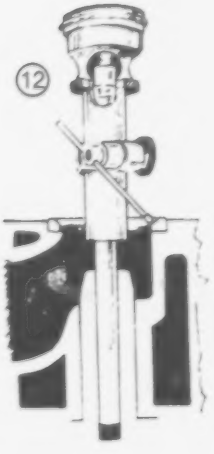


⑬

6. Drive motor (seat grinder)
7. Wheel holder (seat grinder)
8. Carbon scraper
9. Guide cleaner
10. Valve spring tension gauge
11. Wheel dressing tool
12. Valve seat indicator
13. Guide reamer

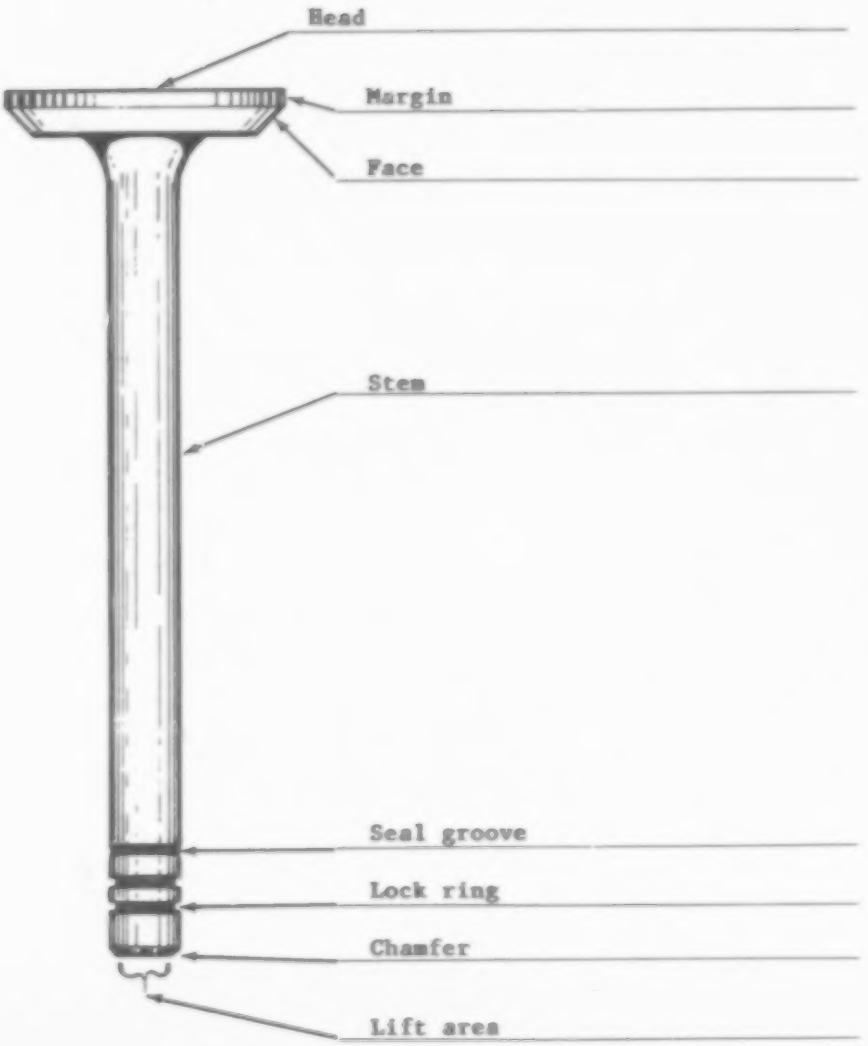
L. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your progress, continue to Learning Step 9. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to Learning Step 9.

SECTION A--ENGINE REBUILDING
UNIT IV--VALVE TRAIN AND CYLINDER HEAD RECONDITIONING

LAP ASSIGNMENT SHEET #4

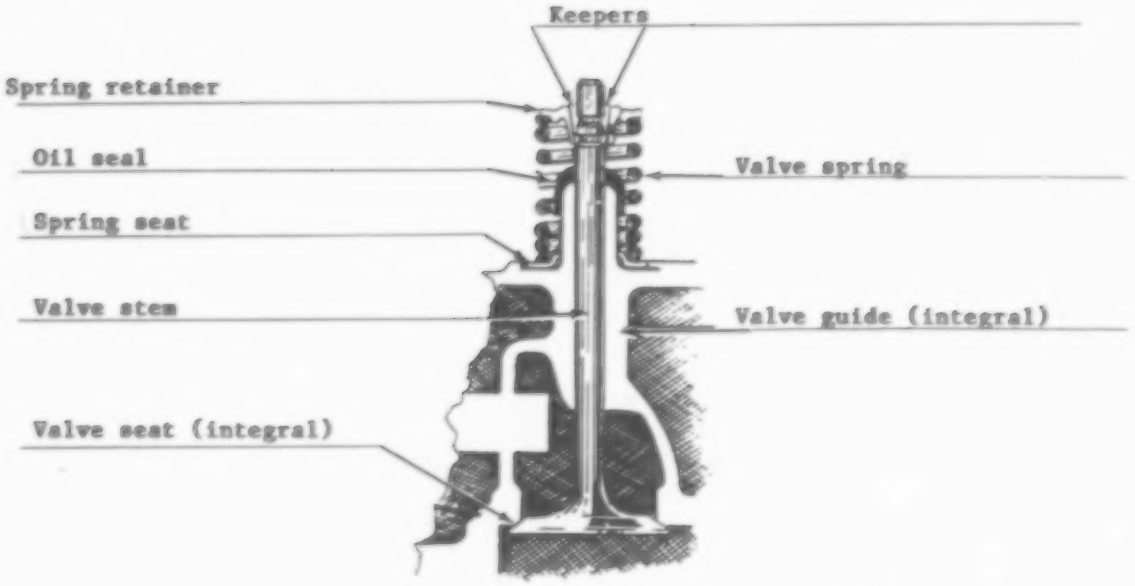
NAME_____ SCORE_____

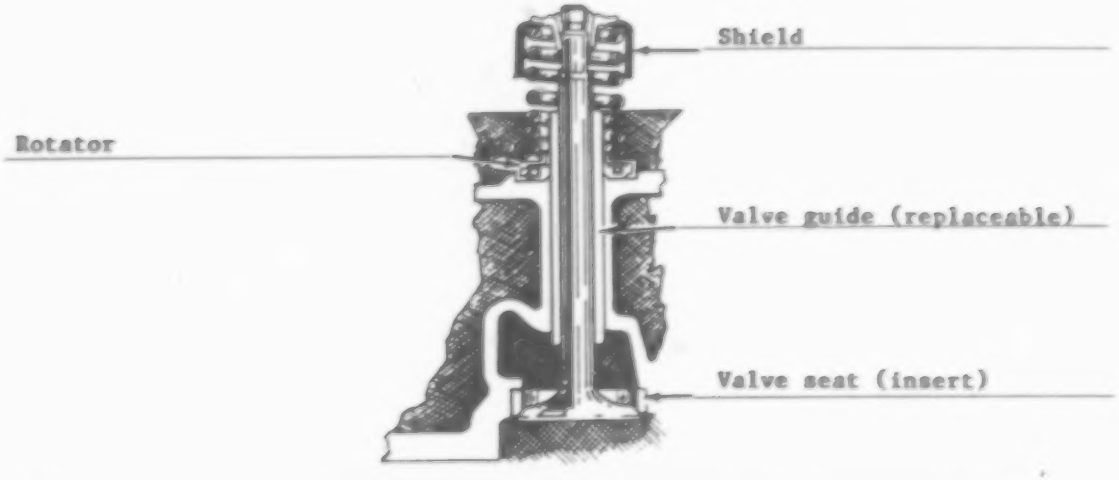
A. Label the parts of the valve shown below. Write the correct names in the blanks.



LAP ASSIGNMENT SHEET #4

B. Label the parts of the valve assemblies shown below. Write the names of the parts in the blanks.





LAP ASSIGNMENT SHEET #4

C. Label the valve springs shown below. Write their names in the blanks below the illustrations.

1. Standard spring

2. Friction damper tube

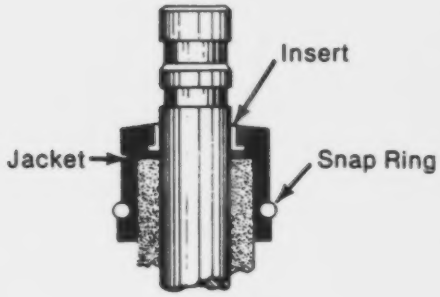
3. Variable rate spring

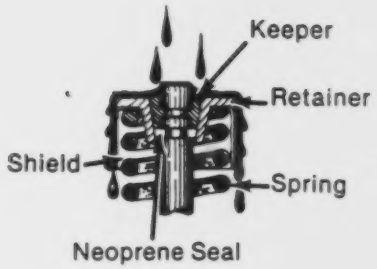
4. Friction damper spring

5. Standard spring with internal assist

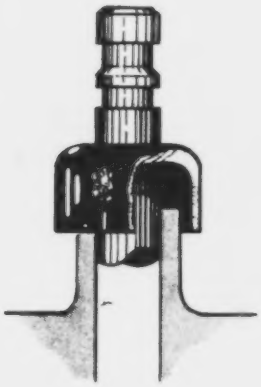
LAP ASSIGNMENT SHEET #4

D. Label the three types of valve stem seals shown below. Write the correct names in the blanks.





1. **Teflon cup** 2. **O-ring**



3. **Cup or umbrella**

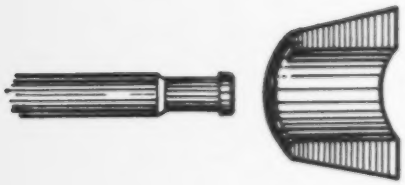
LAP ASSIGNMENT SHEET #4

E. Identify the valve spring keepers shown below. Write their names in the blanks beside the illustrations.

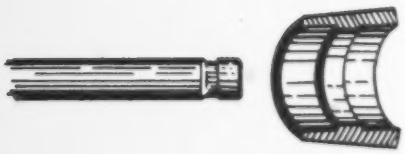
1. Pin type

2. Four-groove conical

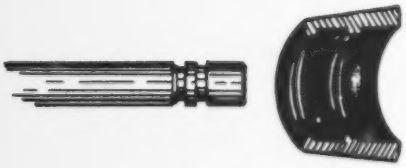
3. Horseshoe



4. Plain conical



5. Single-groove conical

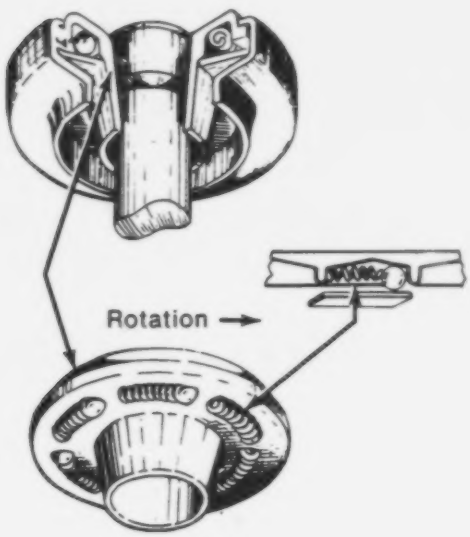


6. Two-groove conical

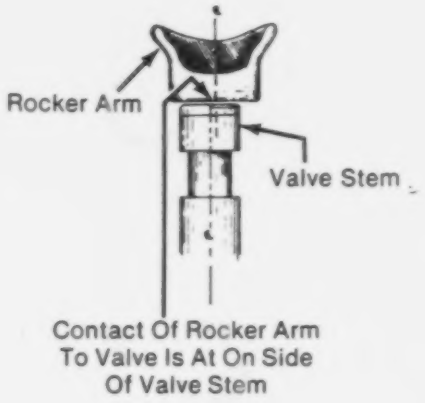
F. What is the purpose of the valve spring spacer?

To maintain correct valve spring installed height.

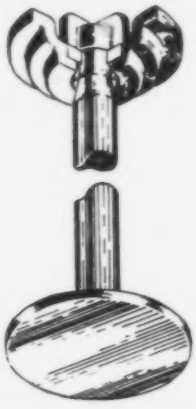
G. Identify the three types of valve rotators shown below. Write their names in the blanks below the illustrations.



1. **Off-center**



2. **Positive**



3. **Free**

LAP ASSIGNMENT SHEET #4

H. What is the purpose of the valve rotator?

To rotate the valve slightly each time it opens.

I. Fill in the missing words in the follow statement.

A valve must seat properly in order to seal the combustion chamber and to enable the valve to cool properly.

J. The following can cause valve burning. Fill in the missing words.

1. Valve not seating properly.
2. Worn valve guides.
3. Exhaust heat riser valve stuck closed.
4. Clogged water jacket or distribution tube.
5. Warped valve seat.
6. Weak or cocked valve springs.
7. Insufficient valve tappet clearance.
8. Engine overheating.
9. Extremely lean air-fuel mixture.
10. Preignition or detonation.
11. Carbon deposits in combustion chamber.

K. Identify the following valve reconditioning tools. Write their names in the blanks next to the illustrations.

1. Seat grinding pilot

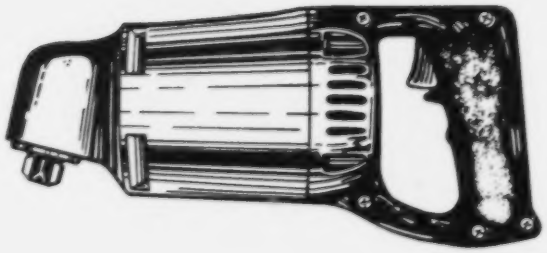
2. Guide cleaner

LAP ASSIGNMENT SHEET #4

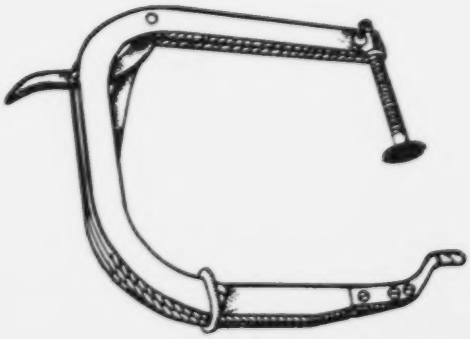
3. Guide reamer

4. Carbon scraper

5. Wheel holder (seat grinder)

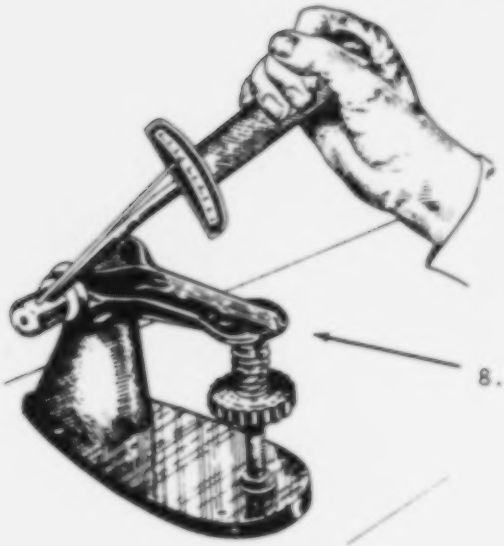


6. Drive motor (seat grinder)



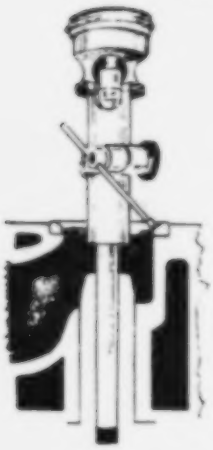
7. Valve spring compressor

LAP ASSIGNMENT SHEET #4

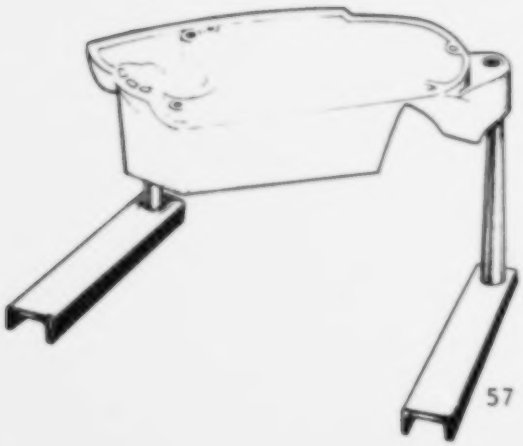


8. Valve spring tension gauge

9. Carbon brush

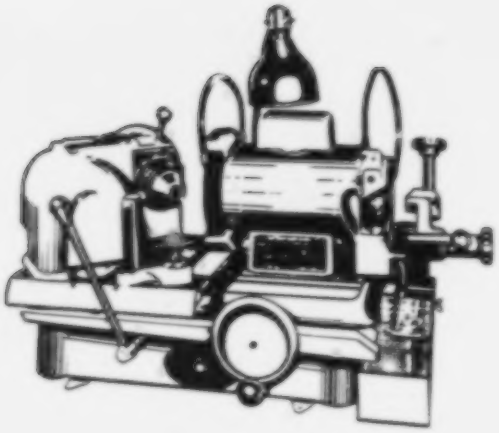


10. Valve seat indicator

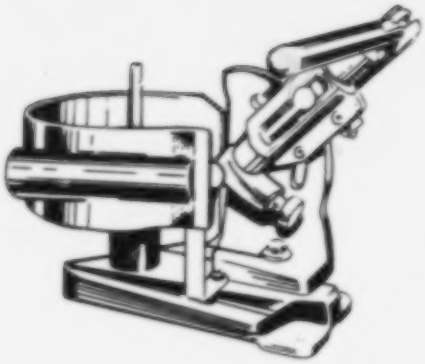


11. Cylinder head stand

57



12. Valve grinding machine



13. Wheel dressing tool

L. Stop. Have your instructor evaluate your Assignment Sheet and mark the area(s) below requiring additional study.

Refer to Information Sheet, Section(s)

___ XII	___ XVI	___ XX
___ XIII	___ XVII	___ XXI
___ XIV	___ XVIII	___ XXII
___ XV	___ XIX	

If none of the above sections are checked, proceed to Learning Step 10. Otherwise, study the required section(s) and then continue to Learning Step 9.

State Department of Vocational and Technical Education CIMC Stillwater, Oklahoma LEARNING ACTIVITY PACKETS

for AUTO MECHANICS II

LAP NO._____ CODE:_____

MAJOR INSTRUCTIONAL AREA SECTION A--ENGINE REBUILDING

INSTRUCTIONAL UNIT UNIT V--ENGINE CRANKSHAFT, BEARINGS, AND OIL PUMP

LEARNING ACTIVITY PACKET NO.	PREREQUISITE LAP(S)
5	1

PURPOSE: This Learning Activity Packet (LAP) outlines the study activities and performance tasks for "Engine Crankshaft, Bearings, and Oil Pump." Accomplishing these procedures will aid the student in attaining a working knowledge of this area of training and in achieving a Skilled or Moderately Skilled competency level in the performance of jobs associated with this specialty.

INTRODUCTION: The course of study in this LAP will help the student become able to identify crankshaft problems, inspect an oil pump, take accurate measurements to evaluate crankshaft and bearing conditions, and make the necessary repairs.

TASKS INCLUDED IN THIS LAP:

1. Check main bearing bore alignment.
2. Measure and inspect a crankshaft.
3. Fit a crankshaft bearing with Plastigauge.
4. Install a rear main bearing seal (crankshaft removed).
5. Disassemble, clean, and inspect an oil pump.

SECTION A--ENGINE REBUILDING
UNIT V--ENGINE CRANKSHAFT, BEARINGS, AND OIL PUMP

LEARNING STEPS

Check the following blanks as you complete the required steps.

_____ 1. Read — Unit and Specific Objectives, page AM II-185-A.

_____ 2. Complete — Engine Crankshaft, Bearings, and Oil Pump Pretest, LAP page 9.

_____ 3. Study — The sections of the Information Sheet, (pages AM II-189-A through 194-A) indicated by your instructor on your pretest.

_____ 4. Refer — To Step 16 of the pretest. If additional study is required continue to Learning Step 5. Otherwise, proceed to Learning Step 7.

_____ 5. Do — LAP Assignment Sheet #1, LAP page 19.

_____ 6. Do — LAP Assignment Sheet #2, LAP page 27.

_____ 7. Check — The following tasks which you feel that you can perform with supervision.

Student Check		Instructor Initials/Date Skilled	Moderately Skilled
_____a.	Check main bearing bore alignment. (10)	_____	_____
_____b.	Measure and inspect a crankshaft. (16)	_____	_____

LEARNING STEPS

Student Check		Instructor Initials/Date Skilled	Moderately Skilled
_____c.	Fit a crankshaft bearing with Plastigauge. (22)	_____	_____
_____d.	Install a rear main bearing seal (crankshaft removed). (28)	_____	_____
_____e.	Disassemble, clean, and inspect an oil pump. (34)	_____	_____

_____ 8. Discuss — Your competency in each task with your instructor. Your instructor will initial each task in which you demonstrate sufficient competency. If all tasks have been initialed, proceed to Learning Step 40. Otherwise, continue to Learning Step 9.

_____ 9. Refer — To Learning Step 7a. If this task has been initialed proceed to Learning Step 15. Otherwise, continue to Learning Step 10.

_____10. Study — Job Sheet #1--Check Main Bearing Bore Alignment, pages AM II-211-A through AM II-213-A.

_____11. Watch — Slide/tape presentation "Check Main Bearing Bore Alignment." (A-V-1)

_____12. Do — Job Sheet #1--Check Main Bearing Bore Alignment.

_____13. Stop. — Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7a and proceed to Learning Step 15. Otherwise, repeat Learning Steps 10 through 12 and continue to Learning Step 14.

_____14.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7a and continue to Learning Step 15. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 7a and continue to Learning Step 15.
_____15.	Refer	To Learning Step 7b. If this task has been initialed, proceed to Learning Step 21. Otherwise, continue to Learning Step 16.
_____16.	Study	Job Sheet #2--Measure and Inspect a Crankshaft, pages AM II-215-A through 218-A.
_____17.	Watch	Video presentation, "Measure and Inspect a Crankshaft." (A-V-2)
_____18.	Do	Job Sheet #2--Measure and Inspect a Crankshaft.
_____19.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7b and proceed to Learning Step 21. Otherwise, repeat Learning Steps 16 through 18 and continue to Learning Step 20.
_____20.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7b and continue to Learning Step 21. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 7b and continue to Learning Step 21.

LEARNING STEPS

____21.	Refer	To Learning Step 7c. If this task has been initialed, proceed to Learning Step 27. Otherwise, continue to Learning Step 22.
____22.	Study	Job Sheet #3--Fit a Crankshaft Bearing with Plastigauge, pages AM II-219-A through AM II-221-A.
_____23.	Watch	Video presentation, "Fit a Crankshaft Bearing with Plastigauge." (A-V-3)
_____24.	Do	Job Sheet #3--Fit a Crankshaft Bearing with Plastigauge.
_____25.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7c and proceed to Learning Step 27. Otherwise, repeat Learning Steps 22 through 24 and then continue to Learning Step 26.
_____26.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7c and continue to Learning Step 27. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 7c and continue to Learning Step 27.
_____27.	Refer	To Learning Step 7d. If this task has been initialed, proceed to Learning Step 33. Otherwise, continue to Learning Step 28.
_____28.	Study	Job Sheet #4--Install a Rear Main Bearing Oil Seal (Crankshaft Removed), pages AM II-223-A through AM II-227-A.

LEARNING STEPS

_____29.	Watch	Slide/tape presentation, "Install a Rear Main Bearing Oil Seal (Crankshaft Removed)." (A-V-4)
_____30.	Do	Job Sheet #4--Install a Rear Main Bearing Oil Seal (Crankshaft Removed).
_____31.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7d and proceed to Learning Step 33. Otherwise, repeat Learning Steps 28 through 30 and then continue to Learning Step 32.
_____32.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7d and continue to Learning Step 33. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 7d and continue to Learning Step 33.
_____33.	Refer	To Learning Step 7e. If this task has been initialed, proceed to Learning Step 39. Otherwise, continue to Learning Step 34.
_____34.	Study	Job Sheet #5--Disassemble, Clean, and Inspect an Oil Pump, pages AM II-229-A through 236-A.
_____35.	Watch	Slide/tape presentation "Disassemble, Clean, and Inspect an Oil Pump." (A-V-5)
_____36.	Do	Job Sheet #5--Disassemble, Clean, and Inspect an Oil Pump.

_____37.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7e and proceed to Learning Step 39. Otherwise, repeat Learning Steps 34 through 36 and then continue to Learning Step 38.
_____38.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 7e and continue to Learning Step 39. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 7e and continue to Learning Step 39.
_____39.	Refer	To Learning Step 7. If all tasks have been initialed, continue to Learning Step 40. Otherwise, refer to the step indicated in parentheses after the unsigned task.
_____40.	Review	Information Sheet (pages AM II-189-A through 194-A) and LAP Assignment Sheets.
_____41.	Take	Engine Crankshaft, Bearings, and Oil Pump Test (see your instructor). If your score is 85 percent or above, continue to the next assigned Learning Activity Packet. Otherwise, ask your instructor about additional study requirements and possible retesting.

SECTION A--ENGINE REBUILDING
UNIT V--ENGINE CRANKSHAFT, BEARINGS, AND OIL PUMP

PRETEST

NAME _____ SCORE _____

DIRECTIONS: This pretest is to determine how much you already know about crankshafts, bearings, and oil pumps. Your performance on this pretest will not be used to determine your grade in the course. Instead, it will guide your instructor in designing this course to meet your needs. If you are unsure of the answer to a question, do not guess. Guessing may prevent you from receiving needed instruction.

1. Define the following terms.

   a. Bearing--Supports moving load with minimum friction (drag)

   b. Bearing tang--Used to correctly locate bearing during assembly

   c. Bore--Diameter of a hole

   d. Bushing--Spacing device; usually a sleeve

   e. Cast--Process of making parts by pouring molten metal into a mold

   f. Forging--Process of hammering or compressing hot metal into a shape

   g. Crankpin--Part of the crankshaft where connecting rod fastens

   h. Bearing crush--Distortion of bearing shell

   i. Idler gear--Rotating gear that does not transfer a load

   j. Journal--Surface on which a bearing operates

   k. Pilot bearing--Bearing in crankshaft that supports the clutch shaft

   l. Plastigauge--Plastic thread used to measure clearances by amount of crush

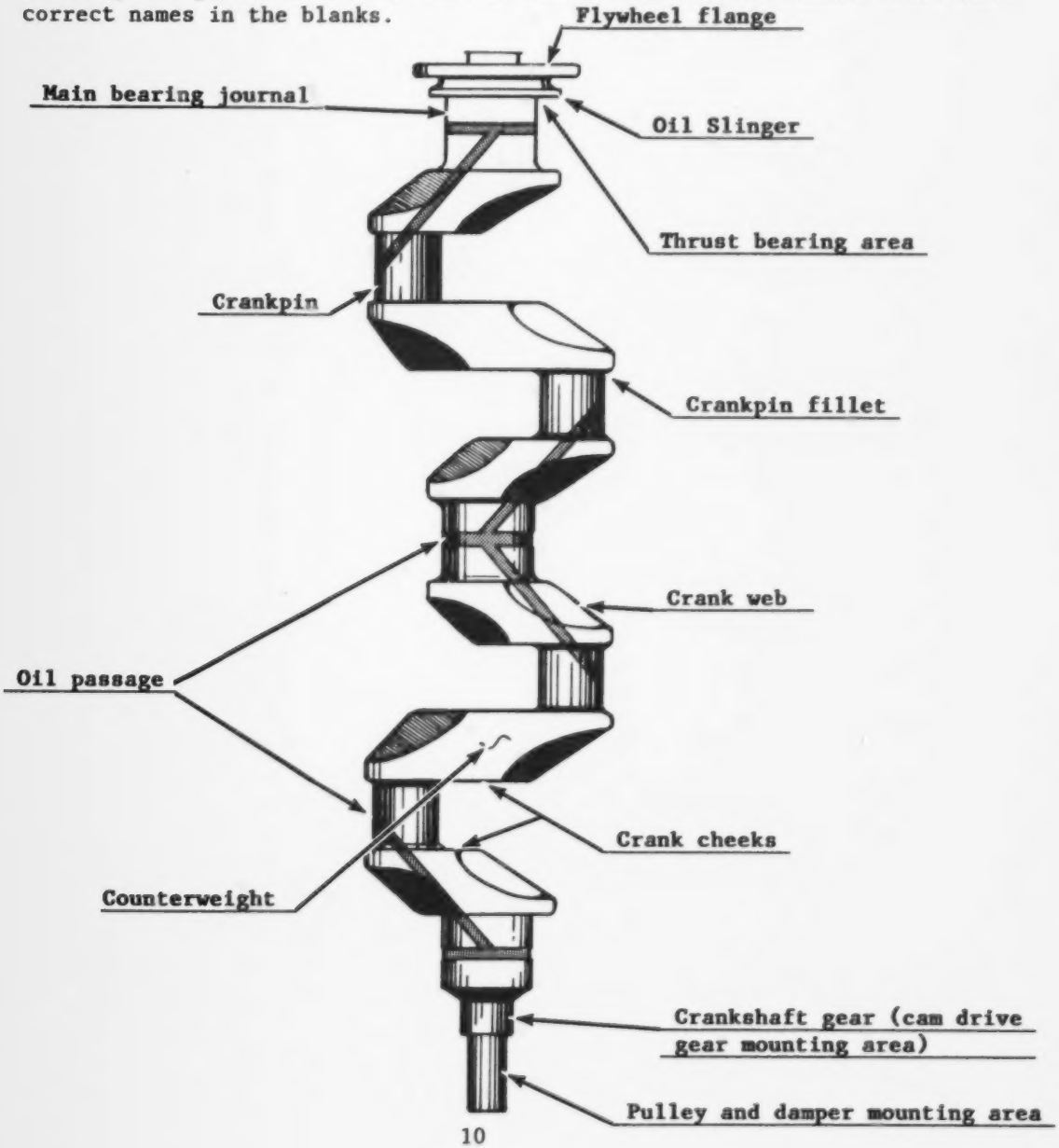
   m. Torsional vibration damper--Device mounted on front of crankshaft to reduce twisting vibration of crankshaft

   n. Bearing spread--Slightly larger arc in the split sleeve bearing than in the bearing housing bore

2. Describe the purpose of the crankshaft.

Converts reciprocating motion of the pistons into rotating motion.

3. Identify the parts of the crankshaft in the illustration below. Write the correct names in the blanks.

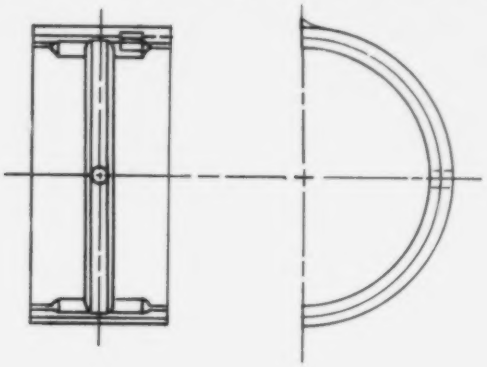


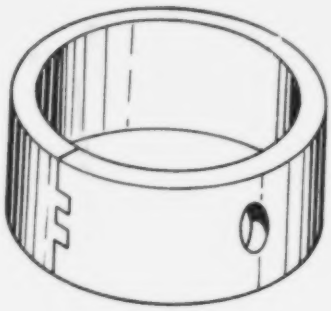
4. What are the two primary methods of producing crankshafts?

   a. Casting

   b. Forging

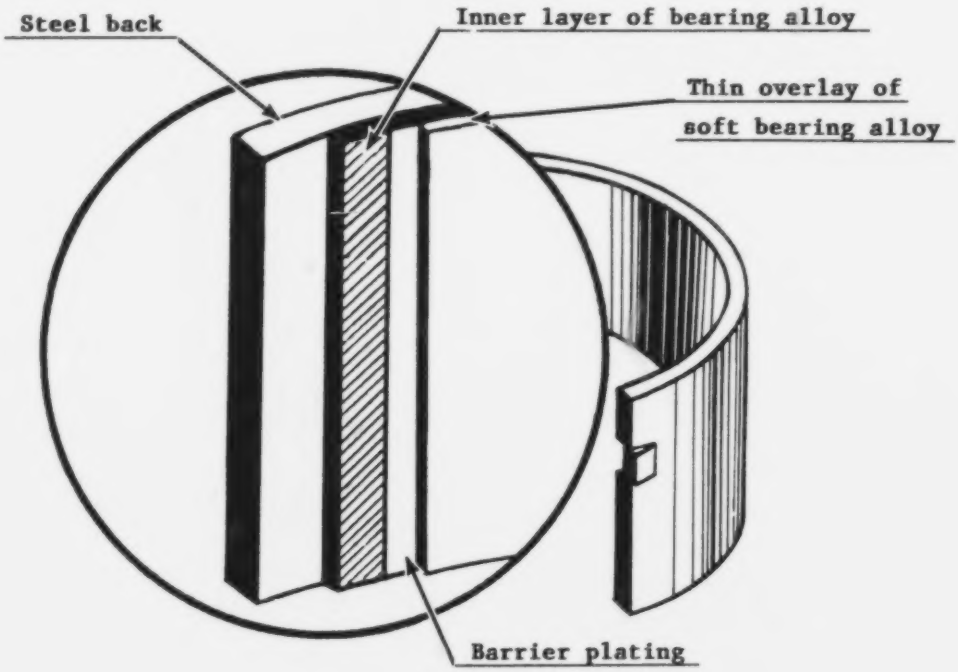
5. Identify the bearings illustrated below. Write their names in the blanks.





   a. Split sleeve b. Sleeve

6. Identify the layers in the insert bearing illustrated below. Write the correct names of the layers in the blanks.



7. Define bearing spread and bearing crush.

Bearing spread--Helps hold the bearing in place during installation; wider than housing bore.

Bearing crush--Holds bearing in place by exerting pressure of at least 12,000 psi on the bearing surface. Prevents bearing from turning while engine is running.

8. Define the bearing requirements listed below.

a. Load-carrying capacity--Ability to support centrifugal and combustion forces

b. Embeddability--Ability to permit particles to press into soft materials in order to protect surfaces

c. Fatigue resistance--Ability to withstand severe pressures and bending

d. Conformability--Ability of bearing to deform slightly to allow for slight variations in shaft alignment and journal shape

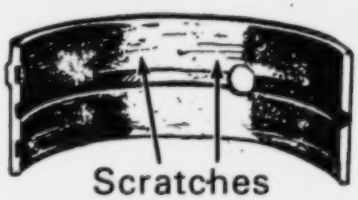
e. Corrosion resistance--Ability to withstand deterioration caused by normal combustion byproducts

f. Wear rate--Ability of a bearing to withstand a long service life.

9. Identify the cause of each bearing failure in the following illustrations. Write the reasons for the failures in the blanks.

Overlay Gone
From Entire Surface

a. Tapered journal



Scratches

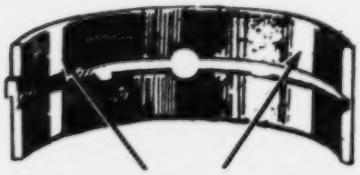
b. Scratched by dirt

Wiped Out

c. Lack of oil

Radius Ride

d. Radius ride



Bright (Polished)
Sections

e. Improper seating

Craters or Pockets

f. Fatigue failure

10. Describe the action of lubricating oil on an insert bearing.

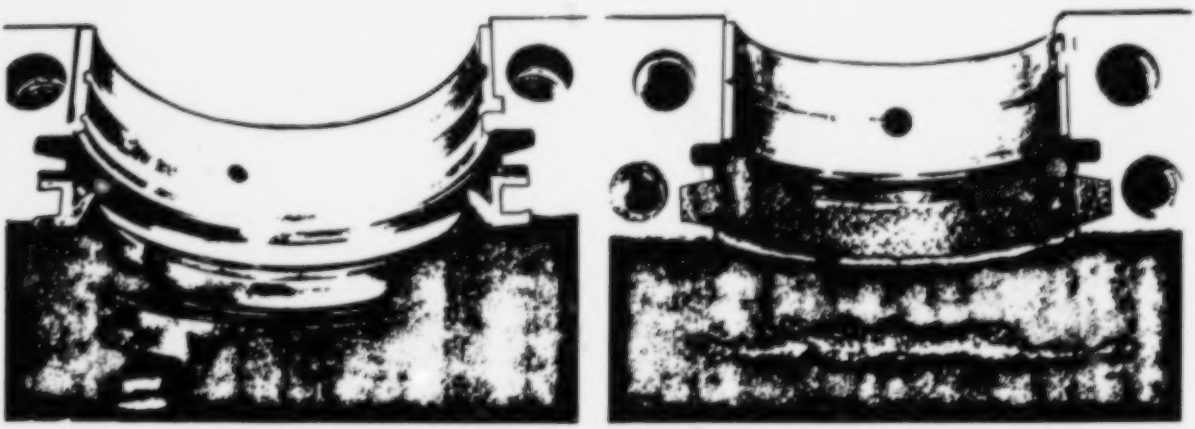
Oil forms a film on bearing surface and separates bearing and shaft, preventing metal-to-metal contact

11. Explain the purposes of the torsional vibration damper and the flywheel.

Torsional vibration damper--Reduces twisting of crankshaft caused by cylinder firing impulse

Flywheel--Evens out power surges during power strokes

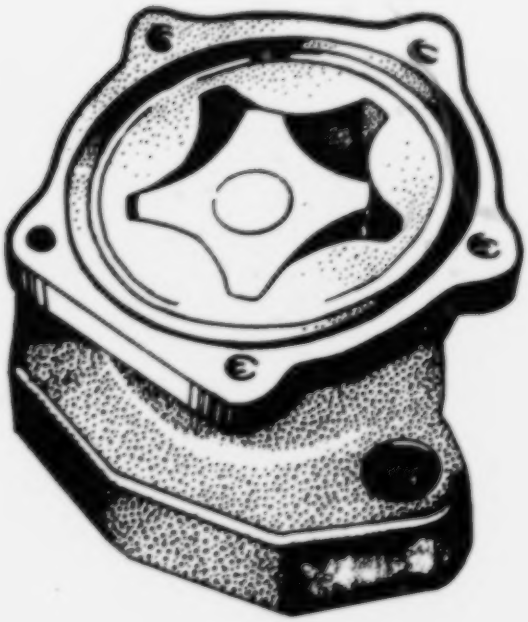
12. Identify the two types of rear main bearing oil seals. Write the correct names in the blanks below the illustrations.

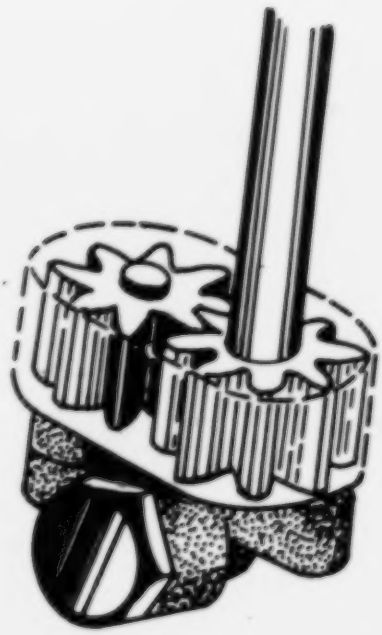


a. Lip-type seal

b. Rope-type seal

13. Identify the two main types of oil pumps shown below. Write the correct names in the blanks below the illustrations.

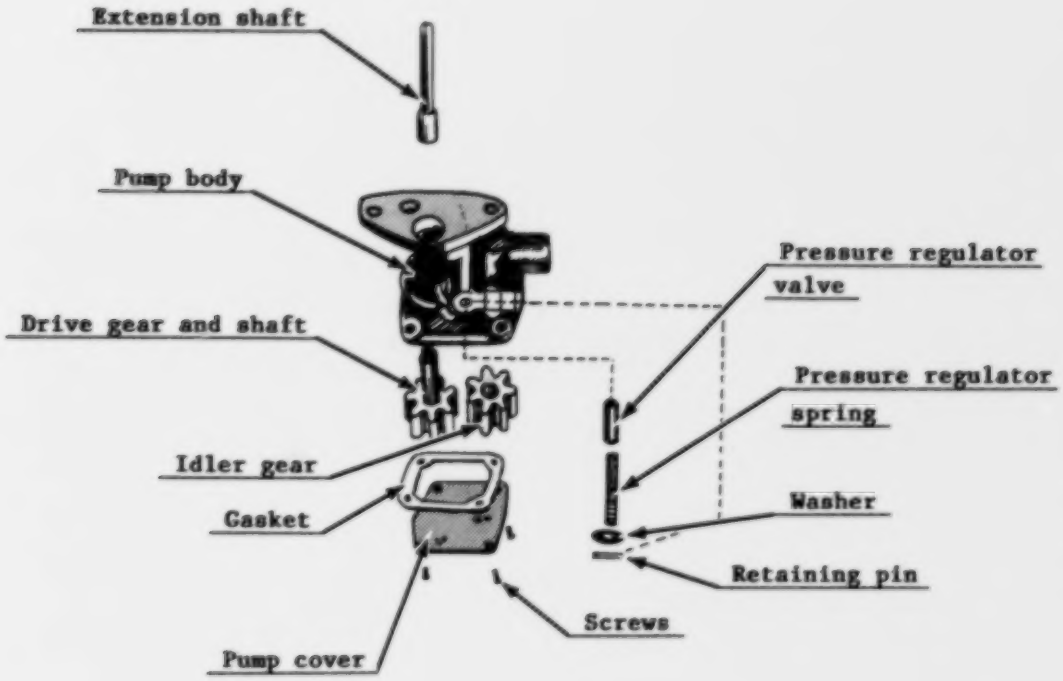




a. Rotor

b. Gear

14. Identify the parts of the oil pump in the illustration below. Write the names of the parts in the blanks.



15. List six conditions that can lower oil pressure.

ANSWER SHOULD INCLUDE ANY SIX OF THE FOLLOWING.

a. Low oil level

b. Excessive main bearing clearance

c. Excessive rod bearing clearance

d. Excessive camshaft bearing clearance

e. Worn oil pump

f. Air leak in oil pickup screen or pipe

g. Oil leaks in cylinder block passages

h. Improper oil viscosity

i. Broken oil pressure regulator spring

16. Stop. Have your instructor evaluate your pretest and mark the area(s) below requiring additional study.

Refer to Information Sheet, Section(s):

____I	____VI	____XI
____II	____VII	____XII
____III	____VIII	____XIII
____IV	____IX	____XIV
____V	____X	____XV

You came here from Learning Step 2. If none of the above sections are checked, proceed to Learning Step 7. Otherwise, continue to Learning Step 3.

SECTION A--ENGINE REBUILDING
UNIT V--ENGINE CRANKSHAFT, BEARINGS, AND OIL PUMP

LAP ASSIGNMENT SHEET #1

NAME _____ SCORE _____

A. Match the terms and definitions listed below. Write the correct letters in the blanks.

e 1.	Attached to front of crankshaft; reduces vibration	a. Bearing spread
d 2.	Rotating gear with no load transfer	b. Journal
a 3.	Slightly larger arc in split-sleeve bearings	c. Crankpin
n 4.	Distortion of bearing shell; prevents bearing spin	d. Idler gear
b 5.	Surface on which bearing operates	e. Harmonic balance
f 6.	Hammering or pressing metal into desired shape	f. Forging
k 7.	Pouring molten metal into a mold	g. Cylinder bore
c 8.	Part of crankshaft where connecting rod attaches	h. Bearing tang
i 9.	Material used to measure clearances by amount of crush	i. Plastigauge
l 10.	Supports a moving load with minimum drag	j. Pilot bearing
g 11.	Diameter of cylinder hole in engine block	k. Casting
j 12.	Supports the clutch shaft	l. Bearing
m 13.	Sleeved spacer	m. Bushing
h 14.	Used to correctly locate bearing during assembly	n. Bearing crush

B. Fill in the missing words in the statement below.

The purpose of the crankshaft is to convert the reciprocating motion of the pistons into a rotating motion.

C. Match names of parts of the crankshaft and their locations. Write the correct numbers in the blanks.

__12__ Pulley and damper mounting area

__4__ Counterweight

__9__ Crank web

__7__ Thrust bearing area

__5__ Flywheel flange

__2__ Crankpin (connecting rod journal)

__3__ Oil passage

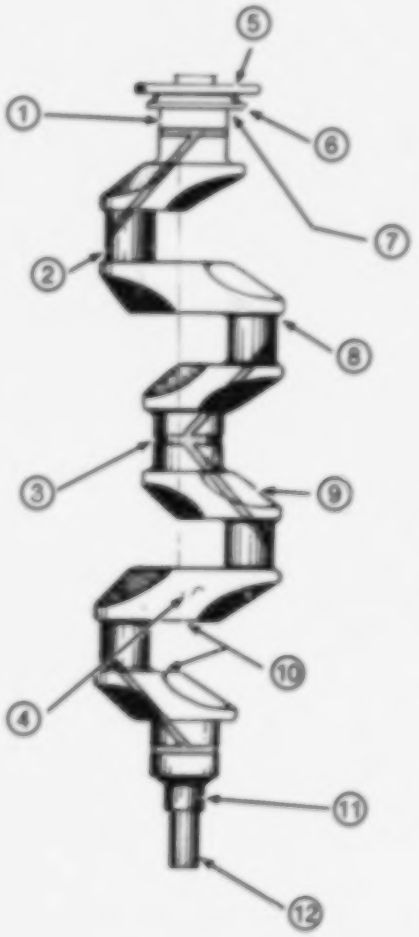
__6__ Oil slinger

__1__ Main bearing journal

__8__ Crankpin fillet

__11__ Crankshaft gear (camdrive gear mounting area)

__10__ Crank check

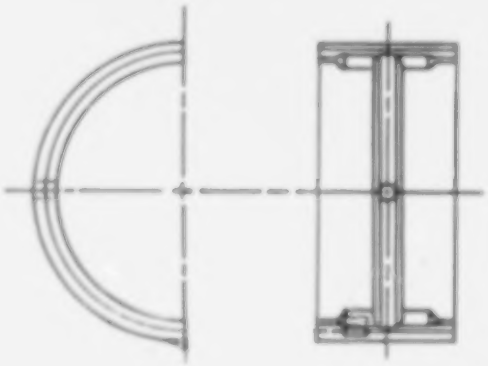


LAP ASSIGNMENT SHEET #1

D. Fill in the missing words in the statement below.

Crankshafts are made two ways. Either by casting, which is a molding process, or by forging, which is a compression process.

E. Identify the two bearing types shown below and give one example of where each is used in the engine.



a. Sleeve type

b. Used for cam bearings

c. Split-sleeve type

d. Used for rod and main bearings

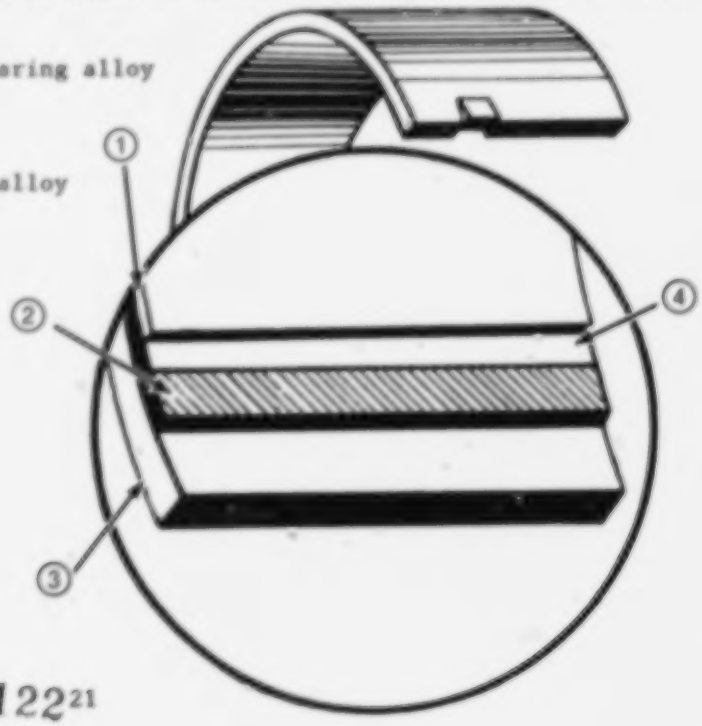
F. Match the locations and names of parts of an insert bearing. Write the correct numbers in the blanks.

1 Thin overlay of soft bearing alloy

4 Barrier plating

2 Inner layer of bearing alloy

3 Steel back



G. Fill in the missing words in the following statements.

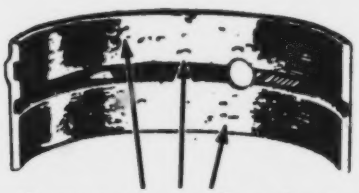
1. Bearing __crush__ holds the bearing in place. __Crush__ must exert a force of at least __12,000__ psi to keep the bearing from __moving__ when the engine runs.

2. Bearing __spread__ is from __0.005__" to __0.020__" wider than the __housing bore__.

H. Match bearing requirements and definitions listed below. Write the correct letters in the blanks.

__d__ 1.	Resistance to pressures and bending	a. Wear rate
__c__ 2.	Ability of bearing surface to adjust to variations in shaft alignment	b. Embeddability
__a__ 3.	Determines length of service life	c. Conformability
__b__ 4.	Ability to prevent foreign particles from damaging shaft surfaces	d. Fatigue resistance
__e__ 5.	Ability to resistss effects of combustion by-products	e. Corrosion resistance
__f__ 6.	Ability to withstand severe centrifugal and combustion forces	f. Load-carrying capacity

I. Identify the causes of the bearing failures in the following illustrations. Write the reason for failure in the blank below each illustration.

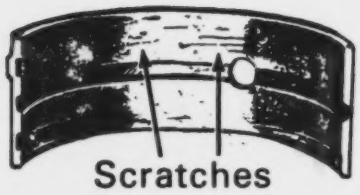


Craters or Pockets

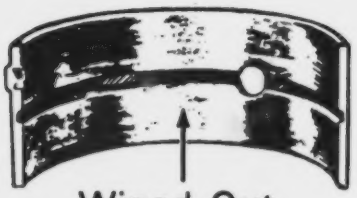
Radius Ride

1. __Fatigue failure__

2. __Radius ride__



Scratches

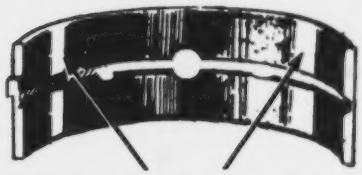


Wiped Out

3. Scratched by dirt

4. Lack of oil

Overlay Gone From Entire Surface



Bright (Polished) Sections

5. Tapered journal

6. Improper seating

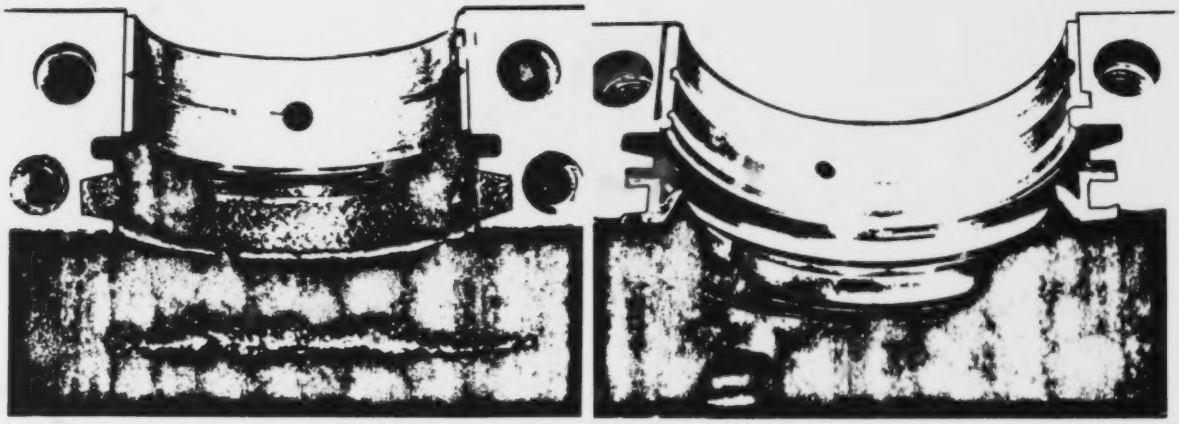
J. Fill in the missing words in the following statements.

1. Lubricating oil on a bearing prevents metal -to- metal contact.

2. The torsional vibration damper resists the twisting action of the crankshaft.

3. The flywheel evens out the power surges from power stroke to power stroke.

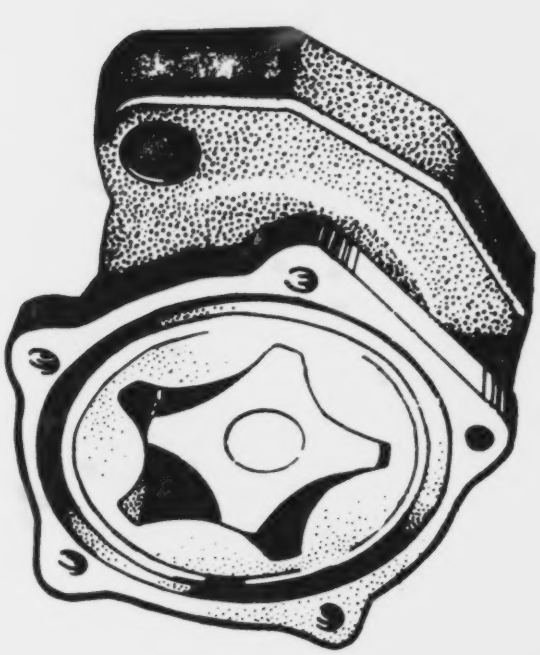
K. Identify the types of rear main bearing oil seals shown below. Write the correct names in the blanks.

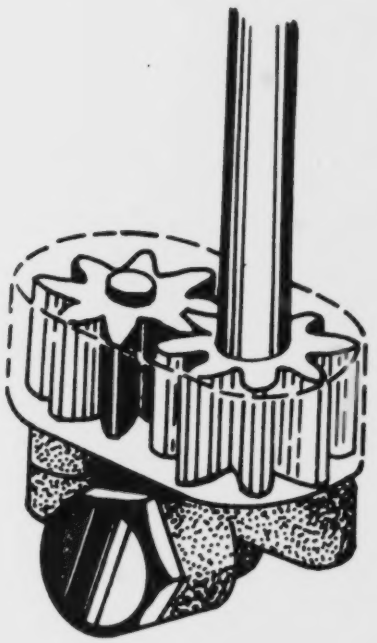


1. Rope type

2. Lip type

L. Identify each type of oil pump shown below. Write their names in the blanks.





1. Rotor

2. Gear

LAP ASSIGNMENT SHEET #1

M. Match the names of the parts and their locations on the oil pump shown below. Write the numbers in the blanks before the correct names of the parts.

__11__ Retaining pin

__2__ Pump body

__4__ Idler gear

__12__ Screws

__5__ Gasket

__10__ Washer

__7__ Pickup screen

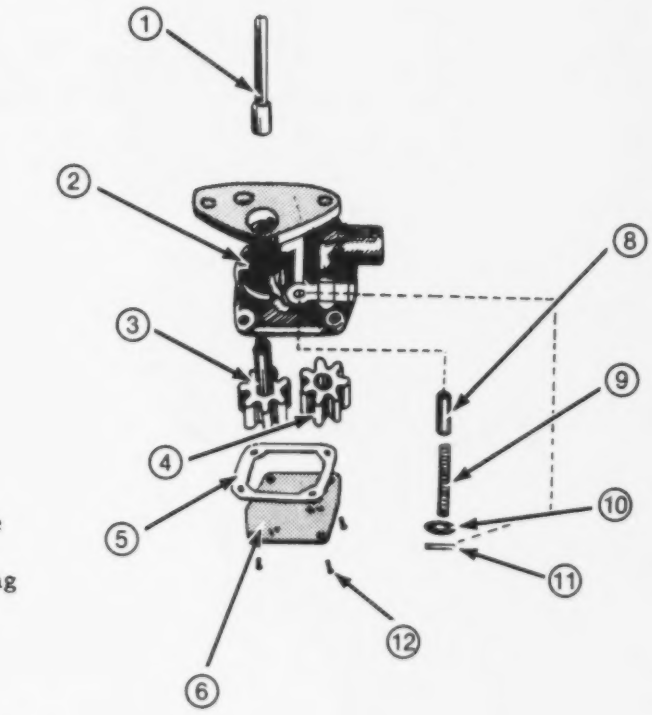
__3__ Drive gear

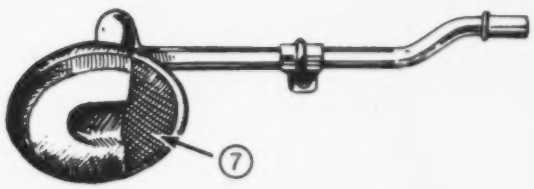
__1__ Extension shaft

__6__ Pump cover

__8__ Pressure regulator valve

__9__ Pressure regulator spring





N. Give nine conditions that could cause low oil pressure.

1. Low oil level
2. Excessive main bearing clearance
3. Excessive rod bearing clearance
4. Excessive camshaft bearing clearance
5. Worn oil pump
6. Air leak in pickup system
7. Low oil viscosity
8. Leak in engine block oil passages
9. Broken oil pressure regulating spring

O. Stop. Have your instructor evaluate your Assignment Sheet and mark the area(s) below requiring additional study.

Refer to Information Sheet, Section(s)

_____I	_____VI	_____XI
_____II	_____VII	_____XII
_____III	_____VIII	_____XIII
_____IV	_____IX	_____XIV
_____V	_____X	_____XV

If none of the above sections are checked, proceed to Learning Step 7. Otherwise, study the required section(s) and then continue to Learning Step 6.

SECTION A--ENGINE REBUILDING
UNIT V--ENGINE CRANKSHAFT, BEARINGS, AND OIL PUMP

LAP ASSIGNMENT SHEET #2

NAME _____ SCORE _____

A. Define the following terms.

1. Bearing spread--Used on split sleeve bearings; has a slightly larger arc than bearing housing bore
2. Journal--Surface on which bearing operates
3. Crankpin--Part of crankshaft where connecting rod attaches
4. Idler gear--Rotating gear that does not transfer a load
5. Torsional vibration damper--Attached to front of crankshaft; reduces twisting vibration in crankshaft (also called harmonic balancer)
6. Forging--Compressing hot metal into a desired shape
7. Bore--Diameter of a hole
8. Bearing tang--Notch or lip used to correctly locate bearing during installation or assembly
9. Plastigauge--Measures clearances by the amount it is crushed between parts
10. Pilot bearing--Located in back end of crankshaft; supports front clutch (pilot) shaft
11. Casting--Pouring molten metal into a mold

12. Bearing-- Surface that supports a moving part with minimum friction

13. Bushing-- Sleeved spacer with an inner bearing surface

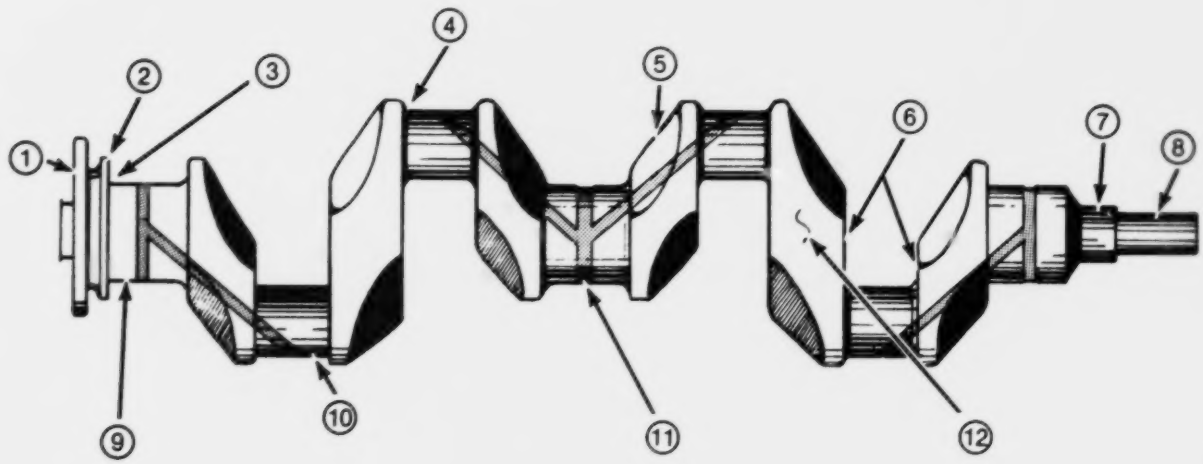
14. Bearing crush-- Holds bearing in place and prevents it from moving while engine is running

B. Fill in the missing words in the statement below.

A crankshaft is a type of converter. It converts reciprocating motion into rotating motion.

C. Identify the parts of the crankshaft shown below. Write the correct names of the parts in the blanks that correspond to the numbers in the illustration.

1. Flywheel flange
2. Oil slinger
3. Thrust bearing area
4. Crankpin fillet
5. Crank web
6. Crank check
7. Crank gear (mount area)
8. Pulley (mount area)
9. Journal
10. Crankpin
11. Oil passage
12. Counterweight



LAP ASSIGNMENT SHEET #2

D. List the two methods of manufacturing crankshafts.

1. Casting

2. Forging

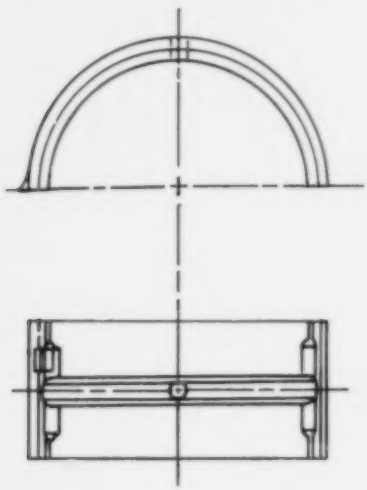
E. Match the names and functions of the bearings shown below. Write the correct numbers in the blanks.

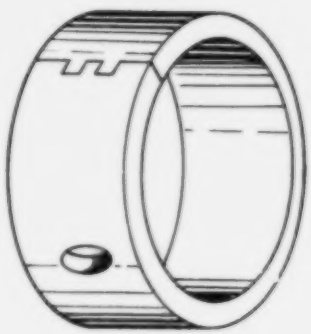
__3__ Sleeve type

__2__ Used in rod and main bearings

__1__ Split-sleeve type

__4__ Used in camshaft bearings





1. Type

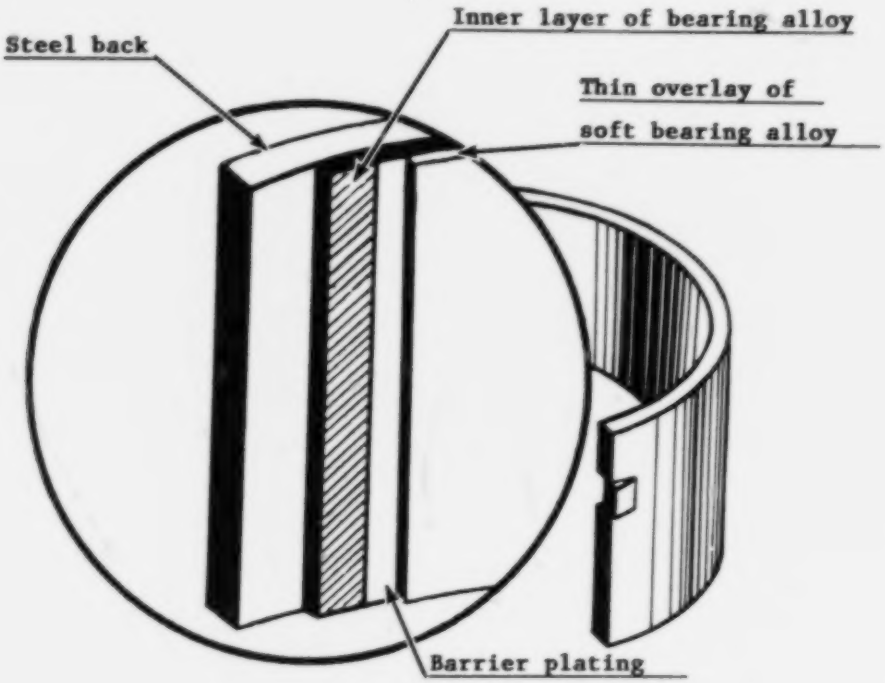
2. Used in _____

3. Type

4. Used in _____

LAP ASSIGNMENT SHEET #2

F. Identify the layers of the bearing shown below. Write the names of the layers in the correct blanks.



G. Define bearing crush and spread.

1. Bearing crush--Exerts pressure of at least 12,000 psi to prevent bearing from moving while engine is running
2. Bearing spread--Bearing arc 0.005" to 0.020" larger than housing bore; helps hold bearing in place during assembly

H. Define the following bearing requirements.

1. Wear rate--Strength of bearing that determines service life
2. Embeddability--Prevents foreign parts from damaging shaft journals by allowing particles to penetrate soft bearing surface

3. Conformability--Ability of bearing surfaces to deform slightly to allow for individual shaft alignment and journals

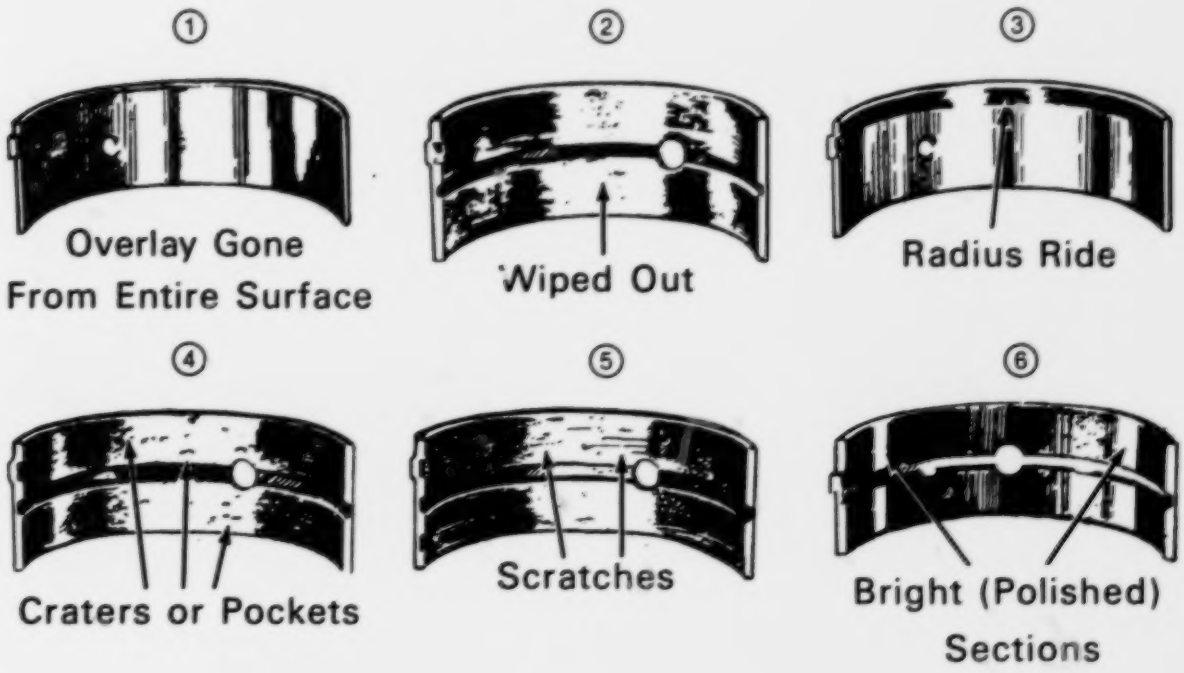
4. Load-carrying capacity--Ability to withstand severe centrifugal and combustion forces

5. Fatigue resistance--Ability to resist pressure and bending

6. Corrosion resistance--Ability to resist harmful effects of combustion byproducts

I. Match the illustrations of bearing failures and the list of causes below. Write the correct numbers in the blanks.

3 Radius ride	2 Lack of oil
5 Foreign particles	1 Tapered journal
6 Improper seating	4 Fatigue failure



LAP ASSIGNMENT SHEET #2

J. Describe the function of lubrication oil on a bearing.

Prevents metal-to-metal contact by forming a film between bearing and journal

K. Describe the purposes of the harmonic balancer and the flywheel.

1. Harmonic balancer--Resists twisting forces exerted on a turning crankshaft

2. Flywheel--Smooths out power surges between power surges

L. Match the rear main bearing oil seals shown and their names. Write the number of each illustration in the blank before its correct name.

__1__ Rope type seal

__2__ Lip type seal

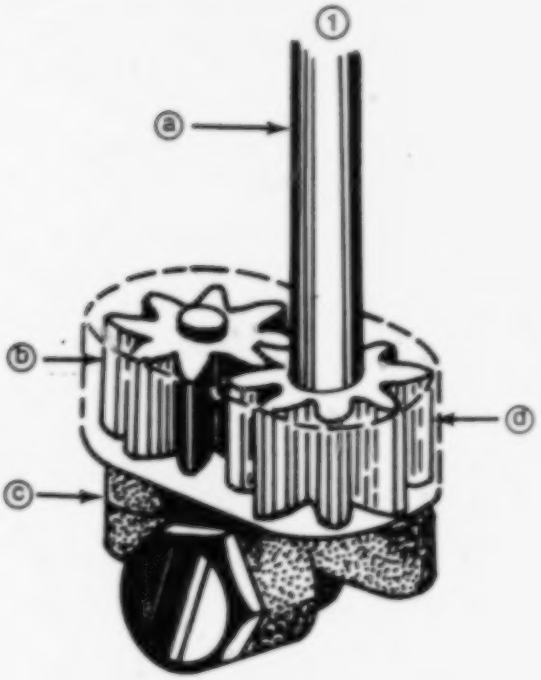
M. Identify types of oil pumps and their parts.

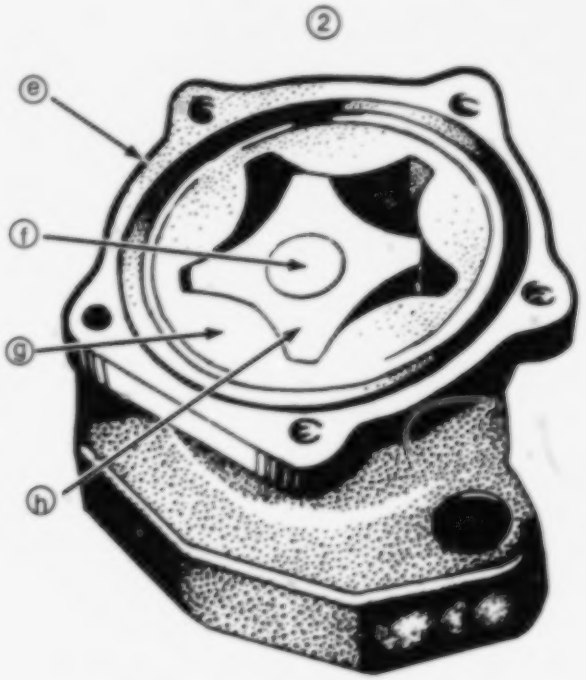
1. Write the number on each illustration in the blank before its correct name.

   1 Gear type

   2 Rotor type

2. Write the name of the parts in the blanks corresponding to the letters on the illustration.





a. Drive shaft

b. Idler gear

c. Pump body

d. Drive gear

e. Pump body

f. Shaft

g. Outer rotor

h. Inner rotor

N. List nine possible causes of low oil pressure.

1. Low oil level
2. Low oil viscosity
3. Air leak in oil pump pickup system
4. Leaks in engine block oil passages
5. Broken oil pressure regulating spring
6. Excessive rod bearing clearance
7. Excessive main bearing clearance
8. Excessive camshaft bearing clearance
9. Worn oil pump

O. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your progress, continue to Learning Step 7. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction continue to Learning Step 7.

State Department of Vocational and Technical Education CIMC Stillwater, Oklahoma LEARNING ACTIVITY PACKETS

for AUTO MECHANICS II

LAP NO. _____ CODE _____

MAJOR INSTRUCTIONAL AREA SECTION A--ENGINE REBUILDING

INSTRUCTIONAL UNIT UNIT VI--CYLINDER AND PISTON RECONDITIONING

LEARNING ACTIVITY PACKET NO. 6

PREREQUISITE LAP(S) 1

PURPOSE: This Learning Activity Packet (LAP) outlines the study activities and performance tasks for "Cylinder and Piston Reconditioning." Accomplishing these procedures will aid the student in attaining a working knowledge of this area of training and in achieving a Skilled or Moderately Skilled competency level in the performance of jobs associated with this specialty.

INTRODUCTION: The course of study in this LAP will help the student become able to identify the parts of a piston, types of cylinder wear, piston damage, and tools and equipment used in piston and cylinder repair. The student should also be able to clean, inspect, measure, repair, and assemble a piston and cylinder assembly.

TASKS INCLUDED IN THIS LAP:

1. Remove piston ring ridge from cylinder.
2. Measure a cylinder for taper, wear, and out-of-round.
3. Hone a cylinder with a glaze breaker hone.
4. Clean cylinder head surface and check for warpage.
5. Remove and replace a cylinder block core plug.

SECTION A--ENGINE REBUILDING
UNIT VI--CYLINDER AND PISTON RECONDITIONING

LEARNING STEPS

Check the following blanks as you complete the required steps.

_____ 1. Read — Unit and Specific Objectives, page AM II-249-A.

_____ 2. Complete — Cylinder and Piston Reconditioning Pretest, LAP page 9.

_____ 3. Study — The sections of the Information Sheet, pages AM II-253-A through 258-A. Be sure to study the transparency masters when required.

_____ 4. Do — LAP Assignment Sheet #1, LAP page 21.

_____ 5. Do — LAP Assignment Sheet #2, LAP page 35.

_____ 6. Check — The tasks below which you feel that you can perform without supervision.

Student Check		Instructor Initials/Date Skilled	Moderately Skilled
_____a.	Remove a piston ring ridge from cylinder. (9)	_____	_____
_____b.	Measure a cylinder for taper, wear, and out-of-round. (15)	_____	_____
_____c.	Hone a cylinder with a glaze breaker hone. (21)	_____	_____
_____d.	Clean the cylinder head surface and check for warpage. (27)	_____	_____
_____ e.	Remove and replace a cylinder block core plug. (33)	_____	_____

LEARNING STEPS

_____ 7.	Discuss	Your competency in each task with your instructor. Your instructor will initial each task in which you demonstrate sufficient competency. If all tasks have been initialed, proceed to Learning Step 39.
_____ 8.	Refer	To Learning Step 6a. If this task has been initialed, proceed to Learning Step 14. Otherwise, continue to Learning Step 9.
_____ 9.	Study	Job Sheet #1--Remove Piston Ring Ridge from Cylinder, pages AM II-289-A and 290-A.
_____10.	Watch	Slide/tape presentation, "Remove Piston Ring Ridge from Cylinder." (A-VI-1)
_____11.	Do	Job Sheet #1--Remove Piston Ring Ridge from Cylinder.
_____12.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 6a and proceed to Learning Step 14. Otherwise, repeat Learning Steps 9 through 11 and then continue to Learning Step 13.
_____13.	Stop.	Have your instructor evaluate your work. If your achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 6a and proceed to Learning Step 14. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 6a and continue to Learning Step 14.
_____14.	Refer	To Learning Step 6b. If this task has been initialed, proceed to Learning Step 20. Otherwise, continue to Learning Step 15.

LEARNING STEPS

_____15.	Study	Job Sheet #2--Measure a Cylinder for Taper, Wear, and Out-of-Round, pages AM II-291-A through 294-A.
_____16.	Watch	Slide/tape presentation, "Measure a Cylinder for Taper, Wear, and Out-of-Round." (A-IV-2)
_____17.	Do	Job Sheet #2--Measure a Cylinder for Taper, Wear, and Out-of-Round.
_____18.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 6b and proceed to Learning Step 20. Otherwise, repeat Learning Steps 15 through 17 and then go to Learning Step 19.
_____19.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 6b and continue to Learning Step 20.
_____20.	Refer	To Learning Step 6c. If this task has been initialed, proceed to Learning Step 26. Otherwise, continue to Learning Step 21.
_____21.	Study	Job Sheet #3--Hone a Cylinder with a Glaze Breaker Hone, pages AM II-295-A and 296-A.
_____22.	Watch	Slide/tape presentation, "Hone a Cylinder with a Glaze Breaker Hone." (A-IV-3)
_____23.	Do	Job Sheet #3--Hone a Cylinder with a Glaze Breaker Hone.

_____24.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 6c and proceed to Learning Step 26. Otherwise, repeat Learning Steps 21 through 23 and then continue to Learning Step 25.
_____25.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 6c and continue to Learning Step 26. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 6c and continue to Learning Step 26.
_____26.	Refer	To Learning Step 6d. If this task has been initialed, proceed to Learning Step 32. Otherwise, continue to Learning Step 27.
_____27.	Study	Job Sheet #4--Clean the Cylinder Head Surface and Check for Warpage, pages AM II-297-A and 298-A.
_____28.	Watch	Slide/tape presentation, "Clean the Cylinder Head Surface and Check for Warpage." (A-IV-4)
_____29.	Do	Job Sheet #4--Clean the Cylinder Head Surface and Check for Warpage.
_____30.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 6d and proceed to Learning Step 32. Otherwise, repeat Learning Steps 27 through 29 and continue to Learning Step 31.

LEARNING STEPS

_____31.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 6d and continue to Learning Step 32. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instuctor initial Learning Step 6d and continue to Learning Step 32.
_____32.	Refer	To Learning Step 6e. If this task has been initialed proceed to Learning Step 38. Otherwise, continue to Learning Step 33.
_____33.	Refer	Job Sheet #5--Remove and Replace a Cylinder Block Core Plug, pages AM II-299-A and 300-A.
_____34.	Watch	Slide/tape presentation, "Remove and Replace a Cylinder Block Core Plug." (A-VI-5)
_____35.	Do	Job Sheet #5--Remove and Replace a Cylinder Block Core Plug.
_____36.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderatly Skilled rating, have your instructor initial Learning Step 6e and proceed to Learning Step 38. Otherwise, repeat Learning Steps 33 through 35 and continue to Learning Step 37.
_____37.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 6e. If additional study is required, discuss a study program with your instructor. Once you have completed that study program to your instructor's satisfaction, have your instructor initial Learning Step 6e and continue to Learning Step 38.

LEARNING STEPS

_____38.	Refer	To Learning Step 6. If all tasks have been initialed, continue to Learning Step 39. Otherwise, refer to the step indicated in parentheses after the unsigned task.
_____39.	Review	Information Sheet (pages AM II-253-A through 258-A) and LAP Assignment Sheets.
_____40.	Take	Cylinder and Piston Reconditioning Test (see your instructor). If your score is 85 percent or above, continue to the next assigned Learning Activity Packet. Otherwise, ask your instructor about additional study requirements and possible retesting.

SECTION A--ENGINE REBUILDING
UNIT VI--CYLINDER AND PISTON RECONDITIONING

PRETEST

NAME _____ SCORE _____

DIRECTIONS: This pretest is to determine how much you already know about cylinder and piston reconditioning. Your performance on this pretest will not be used to determine your grade in the course. Instead, it will guide your instructor in designing this course to meet your needs. If you are unsure of the answer to a question, do not guess. Guessing may prevent you from receiving needed instruction.

1. Define the following terms.

   a. Blow-by--Combustion gases slipping past piston rings and into crank case

   b. Pop-up--Raised part of a piston head

   c. Cylinder block--Basic framework of the engine; contains cylinder bores

   d. Piston slap--Sound made by a piston with excessive skirt clearance

   e. Bore--Diameter of an engine cylinder or hole

   f. Knurl--To roughen a surface by pressing a series of cross-hatched lines into the surface

   G. Ring expander tool--Special tool for piston ring installation

   h. Oil control ring--Lower ring(s); limits how much oil is allowed to enter combustion chamber

   i. Cylinder hone--Abrasive, rotating tool that is used to clean and polish cylinder walls

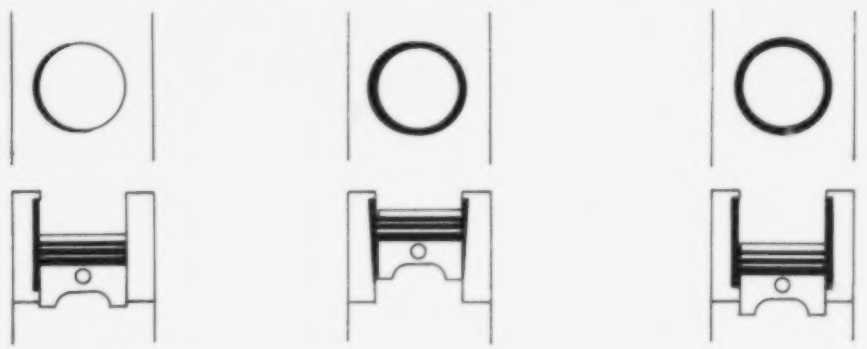
j. Ream-- To enlarge a hole to a specific diameter

k. Lifter valley-- Area between cylinder banks on a V-block engine

l. Lands-- Large-diameter portions of the piston between ring grooves

M. Ring ridge-- Area of cylinder just above upper limit of piston travel

2. Identify the cylinder wear patterns shown below. Write the names of the patterns in the blanks below the illustrations.



a. Out-of-round b. Taper c. Wear

3. List the three methods of cylinder reconditioning.

a. Hone

b. Bore

c. Sleeve replacement

4. List the two types of cylinder sleeves.

a. Wet

b. Dry

5. Give three reasons cylinders become tapered as they wear.

ANSWER SHOULD INCLUDE ANY THREE OF THE FOLLOWING.

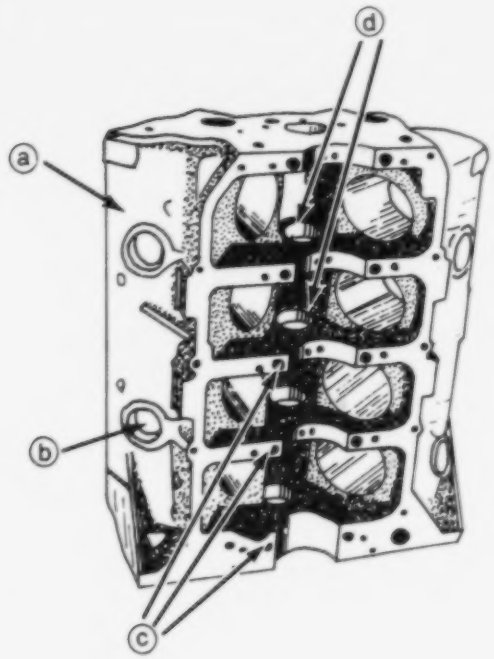
a. There is more heat at the top of cylinder

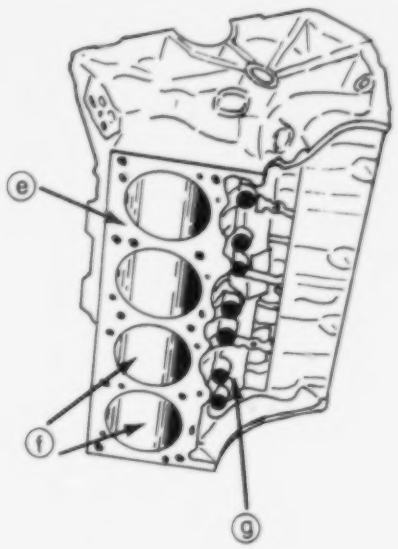
b. Piston ring pressure is greater at top of cylinder

c. There is less lubricating oil at top of cylinder

d. Ring is forced against bottom of groove and out against cylinder wall

6. Identify the parts of the cylinder blocks shown below. Write the names of the parts in the blanks corresponding to the letters in the drawings.





a. Water jacket

b. Core holder

c. Main bearing support

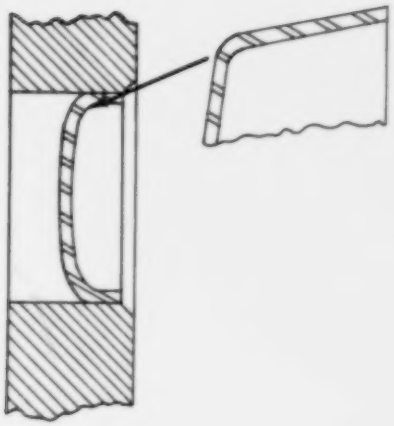
d. Camshaft bore

e. Head mating surface

f. Cylinders

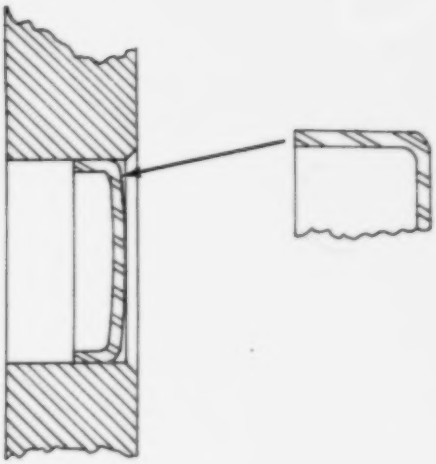
g. Value lifter chamber

7. Identify the types of cylinder block core plugs shown below. Write their correct names in the blanks.



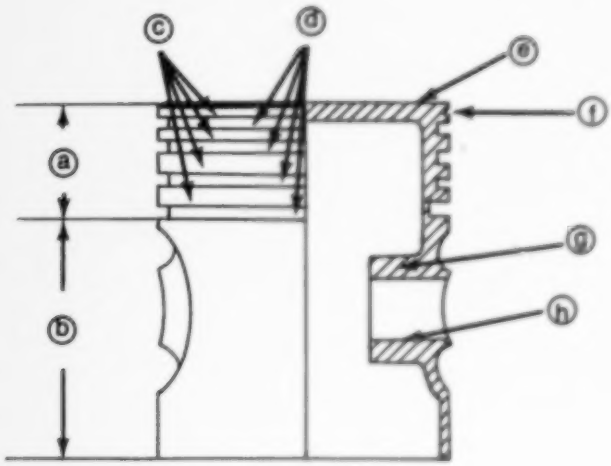
a. Core plug

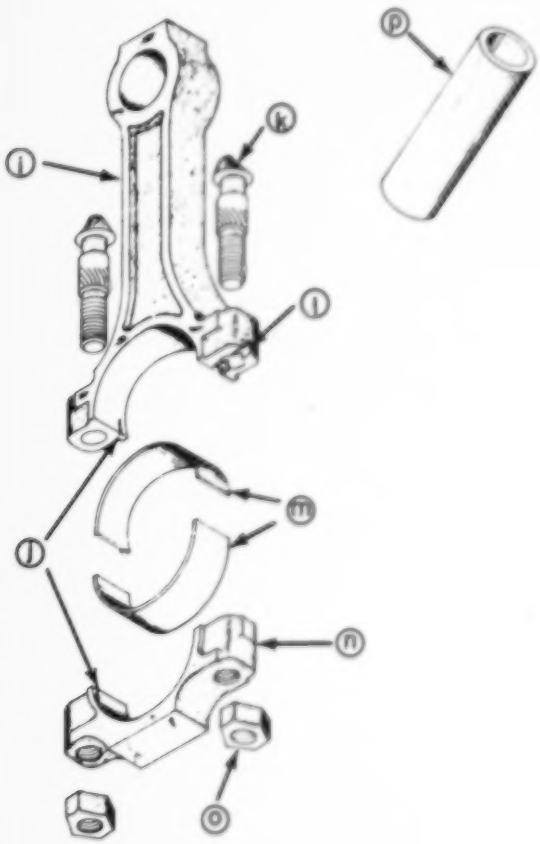
b. Expansion disc plug



c. Expansion cup plug

8. Identify the lettered parts of the piston and connecting rod assembly shown below. Write the correct names of the parts in the corresponding blanks.





a. Ring section
b. Skirt section
c. Ring lands
d. Ring grooves
e. Head
f. Heat dam
g. Pin boss
h. Pin bearing
i. Rod
j. Bearing lock grooves
k. Bolt
l. Spit hole
m. Bearing inserts
n. Rod cap
o. Nut
p. Piston pin

9. Identify the following types of piston rings. Write the correct names in the blanks below the illustrations.

COMPRESSION RINGS

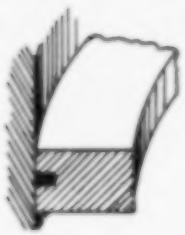
a. Counterbored

b. Chamfered

c. Tapered

d. Scraper

e. Plain



f. Center grooved

OIL RINGS

a. Drilled

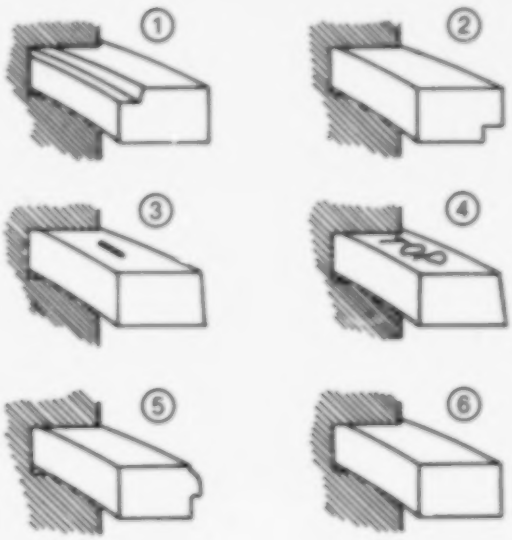
b. Three-piece

c. Slotted

d. Wedge slotted e. Radius slotted

10. Match compression rings and their correct methods of installation. Write the correct numbers in the blanks.

6 a. Either side up
3 b. Dash or dot up
4 c. "Top" up
2 d. Outside groove down
1 e. Inside groove up
5 f. Scraper edge down



11. Describe the correct methods for installing oil rings.

a. One-piece-- Either side up

b. Two-piece-- Expander gap 180 degrees from ring gap

c. Three-piece-- Expander ends butted together; steel rail gaps 180 degrees apart and 90 degrees from expander gap

12. Describe the following methods of piston heat and expansion control.

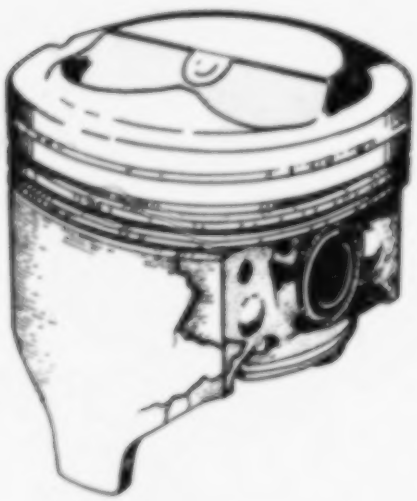
a. Steel band or belt--Cast into piston pin boss; reduces skirt expansion by conducting heat through pin boss

b. Cam ground piston--Cam-shaped skirt that when cold, contacts only cylinder walls in the center; becomes round when piston heats up

c. Slot in piston skirt--T-shaped slot; breaks up heat travel path and allows skirt expansion without increasing piston diameter

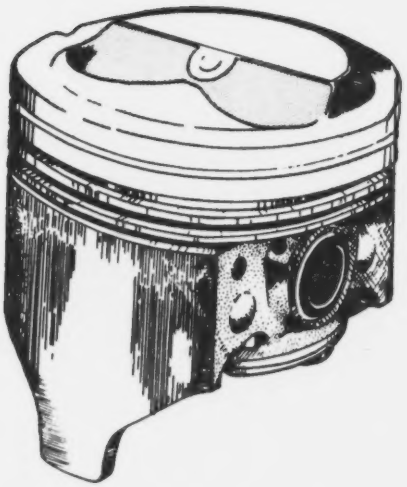
d. Heat dam--Groove around piston head; reduces flow of heat to the skirt

13. Identify causes of piston damage shown in the following illustrations. Write the cause of each type of damage in the blank below the drawing.

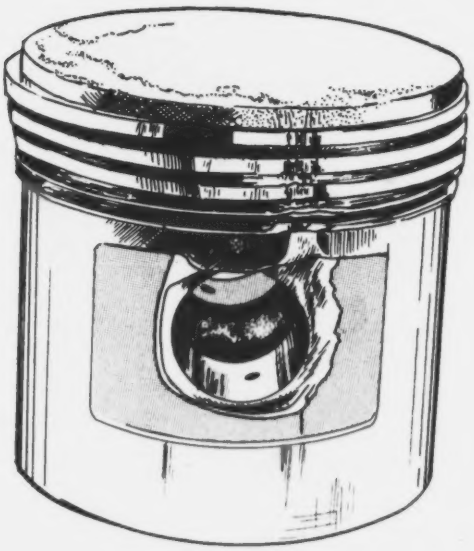


a. Detonation

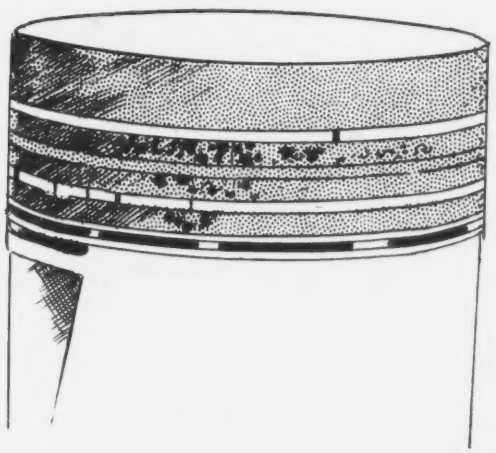
b. Preignition



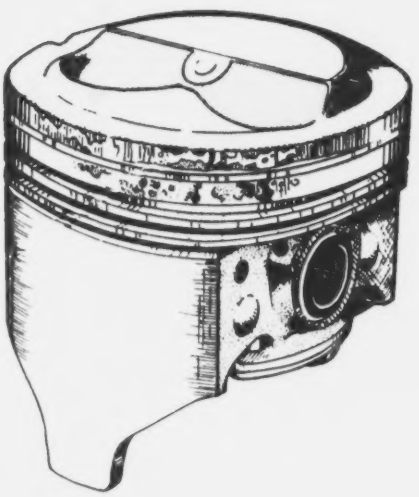
c. Misaligned connecting rod



d. Loose piston pin lock ring



e. Piston rings stuck in grooves



f. Broken piston ring

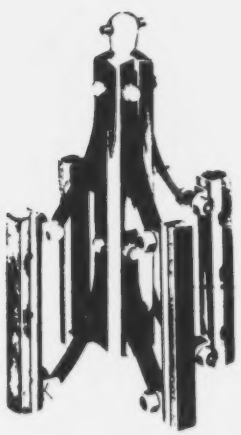
14. List ways to lubricate piston pins and cylinder walls.

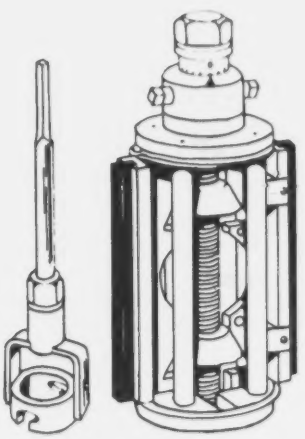
    a. Splash system

    b. Split oil hole in rod

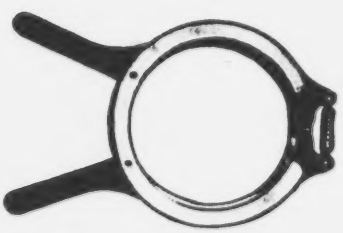
    c. V-groove in rod

15. Identify special tools and equipment used for cylinder and piston reconditioning. Write the names of the tools in the blanks below the drawings.



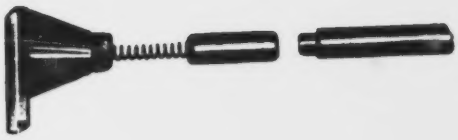


a. Glaze breaker hone b. Boring hone c. Boring bar



d. Ring expander e. Ring compressor

f. Ring groove gauge



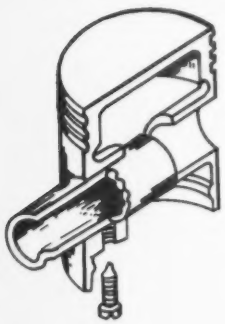
g. Piston pin press

h. Cylinder gauge

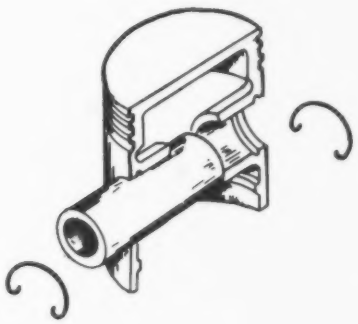
i. Sleeve puller and press

j. Piston gauge and scale

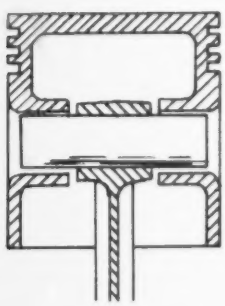
16. Identify the types of piston pin locks shown below. Write their names in the blanks below the drawings.



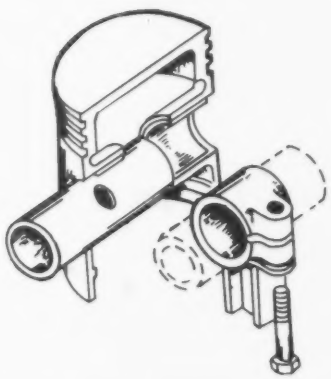
a. Locked to piston



b. Free floating



c. Press fit in rod



d. Locked to connecting rod

17. Stop. Have your instructor evaluate your pretest and mark the area(s) below requiring additional study.

Refer to Information Sheet, Section(s)

____ I	____ V	____ IX	____ XIII	____ XVII
____ II	____ VI	____ X	____ XIV	
____ III	____ VII	____ XI	____ XV	
____ IV	____ VIII	____ XII	____ XVI	

You came here from Learning Step 2. If none of the above sections are checked, proceed to Learning Step 6. Otherwise, continue to Learning Step 3.

SECTION A--ENGINE REBUILDING
UNIT VI--CYLINDER AND PISTON RECONDITIONING

LAP ASSIGNMENT SHEET #1

NAME _____ SCORE _____

A. Match the terms and definitions listed below. Write the correct numbers in the blanks.

1. Area between cylinder bores on a V-block engine
2. Large diameter portion between piston ring grooves
3. To enlarge a hole to a specific size
4. Framework of the engine
5. Tool used to install piston rings on the piston
6. Limits amount of oil that enters combustion chamber
7. Diameter of a hole
8. Used to clean and smooth cylinder walls
9. Sound made by a piston with excessive skirt clearance
10. Raised area of piston head
11. Combustion gases that leak past piston rings and into the crankcase
12. Area of the cylinder above upper travel limit of the piston rings
13. Cross-hatched lines pressed into metal to roughen the surface

__9__ a. Piston slap
__7__ b. Bore
__6__ c. Oil control ring
__11__ d. Blow-by
__3__ e. Ream
__5__ f. Ring expander
__13__ g. Knurl
__8__ h. Cylinder hone
__2__ i. Lands
__12__ j. Ring ridge
__1__ k. Lifter valley
__4__ l. Cylinder block
__10__ m. Pop-up

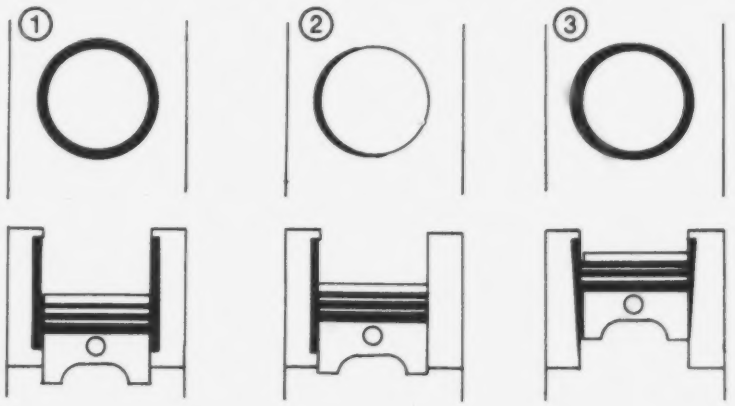
LAP ASSIGNMENT SHEET #1

B. Match the names and illustrations of the three types of cylinder wear patterns shown below. Write the correct numbers in the blanks.

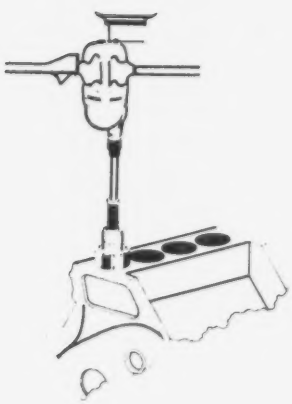
__1__ Wear

__2__ Out-of-round

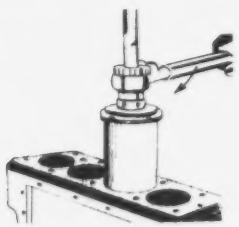
__3__ Taper



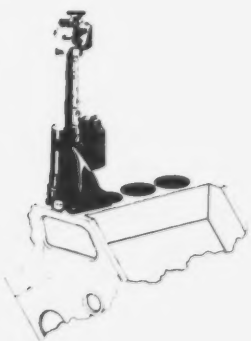
C. Identify the three methods of cylinder reconditioning shown below. Write the name of the method in the blank below each illustration.



1. Hone



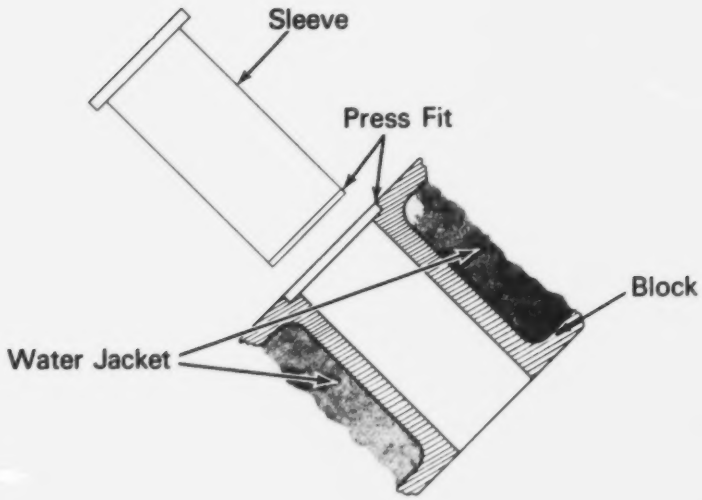
2. Bore



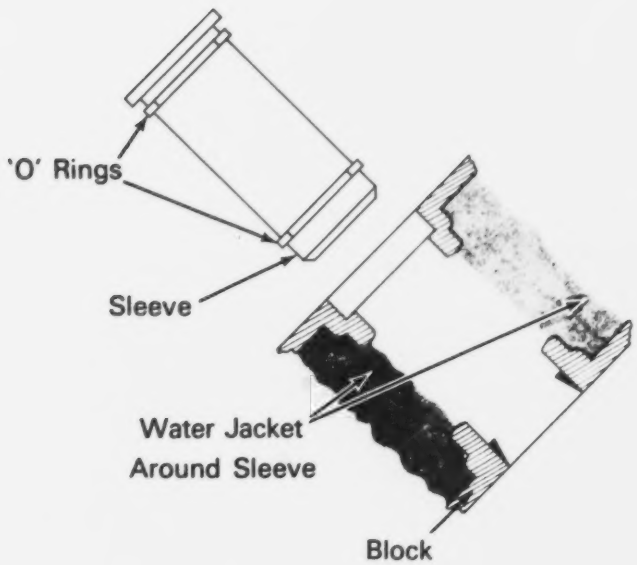
3. Sleeve replacement

LAP ASSIGNMENT SHEET #1

D. Identify each type of cylinder sleeve shown below. Write their names in the blanks.



1. Dry



2. Wet

E. Fill in the missing words in the following statements.

1. ___Cylinders___ normally wear into a tapered shape.
2. Piston ring pressure is created at the ___top___ of the cylinder.
3. Less ___oil___ reaches the upper area of the cylinder; this increases ___friction___.
4. Combustion heat is concentrated in the ___upper___ area of the cylinder.

F. Match the numbered parts and their names on the cylinder blocks shown below. Write the correct numbers in the blanks.

__5__ Core hole

__1__ Valve lifter chamber

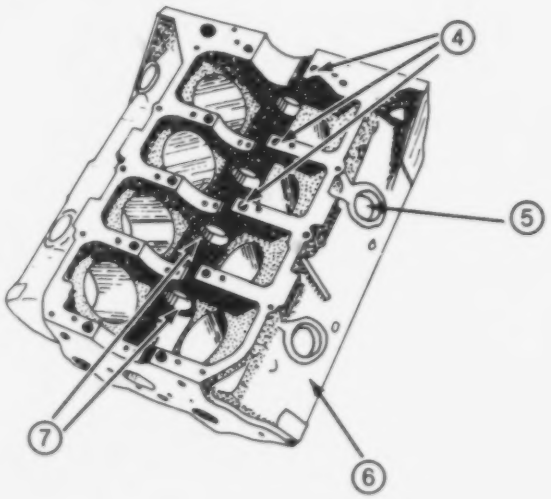
__6__ Water jacket

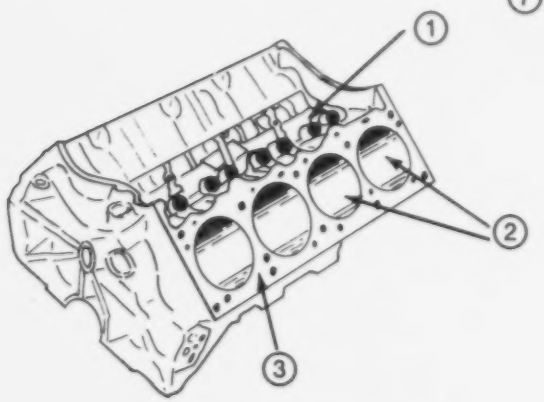
__2__ Cylinders

__4__ Main bearing support

__3__ Head mating surface

__7__ Camshaft bore



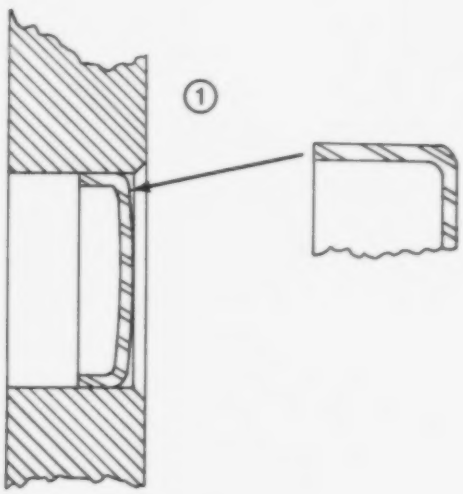


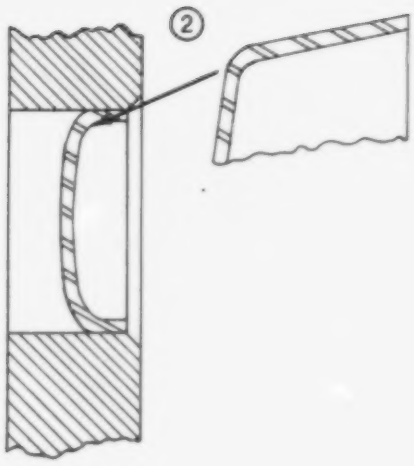
G. Match the names and illustrations of the cylinder block core hole plugs shown below. Write the correct numbers in the blanks.

__3__ Expansion disc plug

__2__ Cup plug

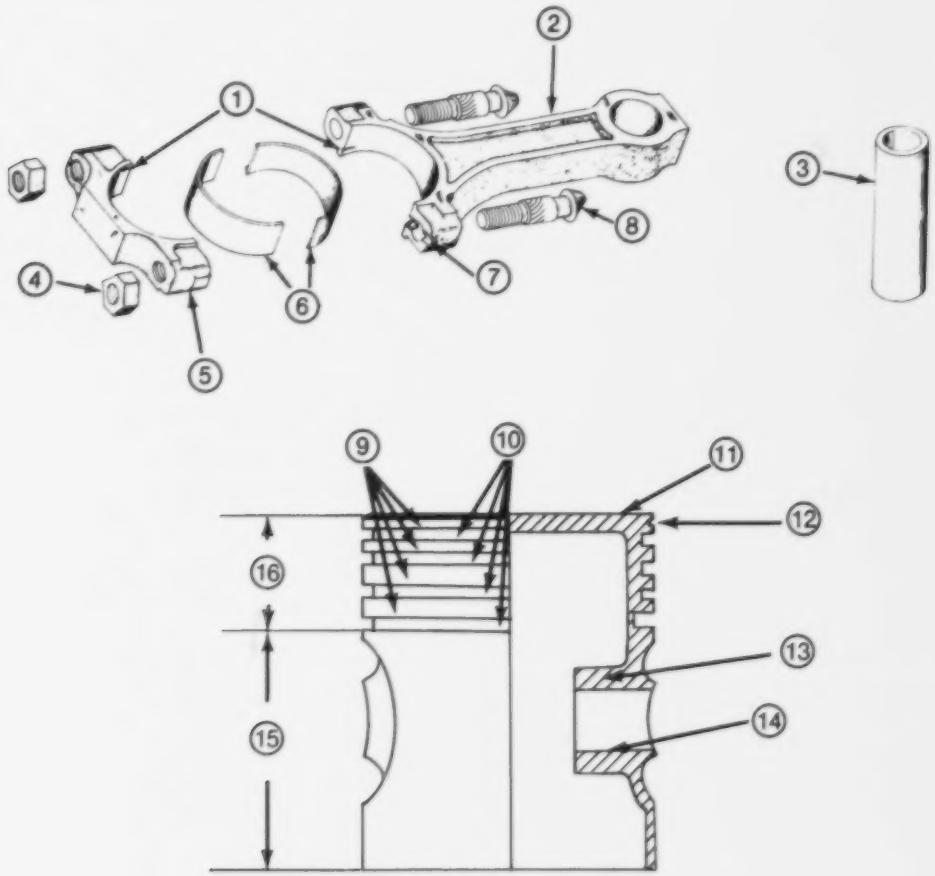
__1__ Expansion cup plug





LAP ASSIGNMENT SHEET #1

H. Identify the parts of the connecting rod assembly and piston shown below. Write the correct names of the parts in the blanks corresponding to the numbers on the drawings.



1. Bearing lock groove
2. Connecting rod
3. Piston pin
4. Nut
5. Rod cap
6. Bearing inserts
7. Split hole
8. Bolt
9. Ring lands
10. Ring grooves
11. Head
12. Heat dam
13. Pin boss
14. Pin bearing

LAP ASSIGNMENT SHEET #1

I. Match the names and the drawings of the compression rings shown below. Write the correct numbers in the blanks.

_4_ Tapered

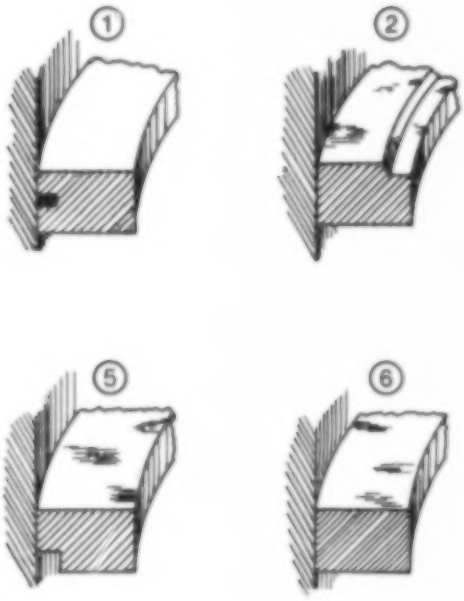
_5_ Scraper

_6_ Plain

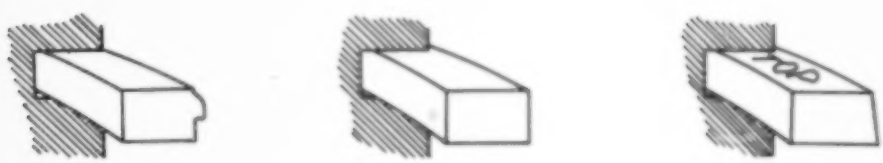
_3_ Chamfered

_2_ Counterbored

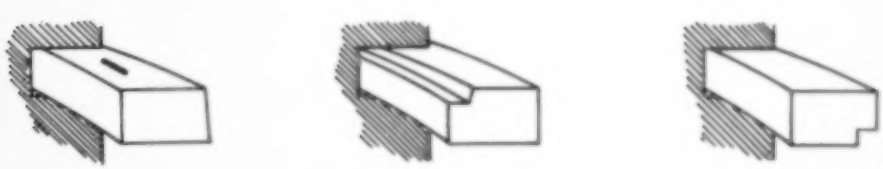
_1_ Center grooved



J. Identify the methods of installing compression rings. Write the name of the method in the blanks below each illustration.



1. Scraper edge down 2. Either side down 3. "Top" up



4. Dash or dot up 5. Inside groove down 6. Outside groove down

K. Match the names and illustrations of the oil rings shown below. Write the correct numbers in the blanks.

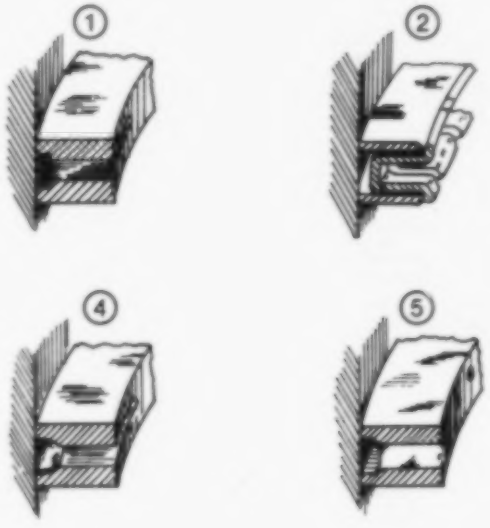
__2__ Three-piece

__1__ Slotted

__5__ Drilled

__3__ Wedge slotted

__4__ Radius slotted



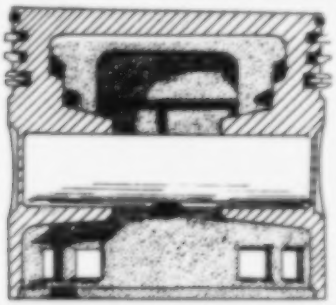
L. Fill in the missing words.

1. There are ___three___ methods of installing oil rings.
2. ___One___ piece rings are installed ___either___ side up.
3. Two piece rings should be installed with the ___expander___ ___gap___ 180° from the ___ring___ ___gap___.
4. Three piece rings should be installed with ___expander___ ends butted together and ___steel___ rail gaps 180° apart, ___90 degrees___ from expander gap.

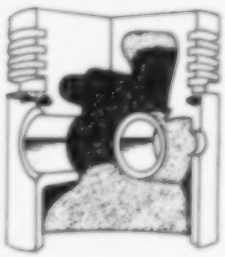
M. List four methods of piston heat and expansion control.

1. ___Heat dam___
2. ___Horizontal or vertical slot in piston skirt___
3. ___Cam ground piston___
4. ___Steel band or belt___

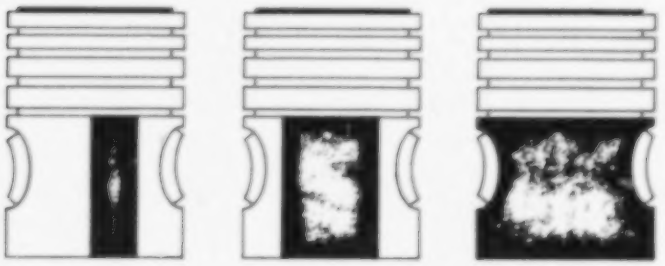
N. Identify the method of piston heat and expansion in each illustration shown below. Write the correct names in the blanks.



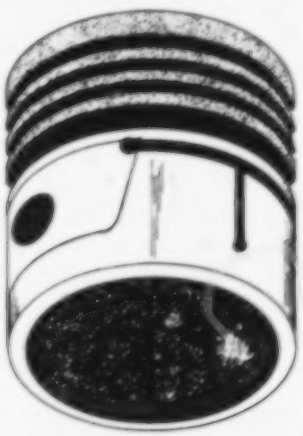
1. Heat dam



2. Belt



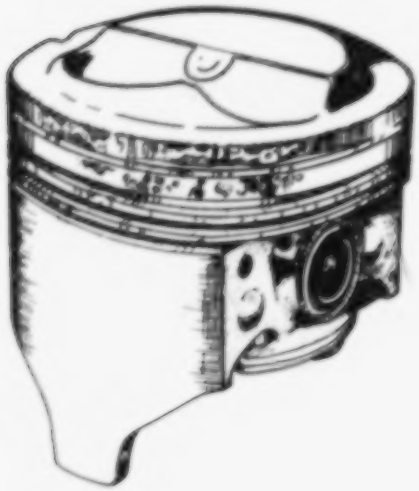
3. Cam ground piston



4. Horizontal or vertical slot

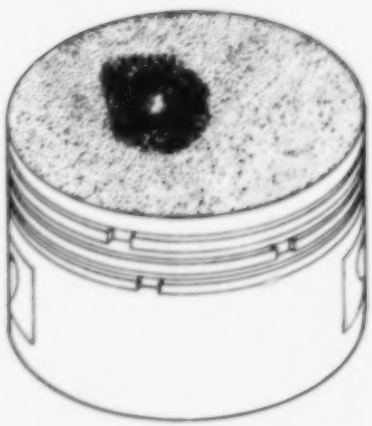
LAP ASSIGNMENT SHEET #1

O. Identify the cause of damage on each of the following pistons. Write the causes in the blanks below the drawings.



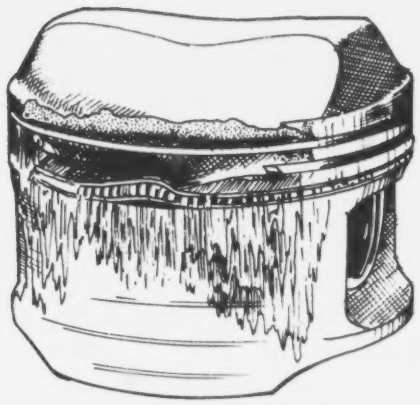
1. Broken ring

2. Stuck rings



3. Preignition

4. Misaligned connecting rod

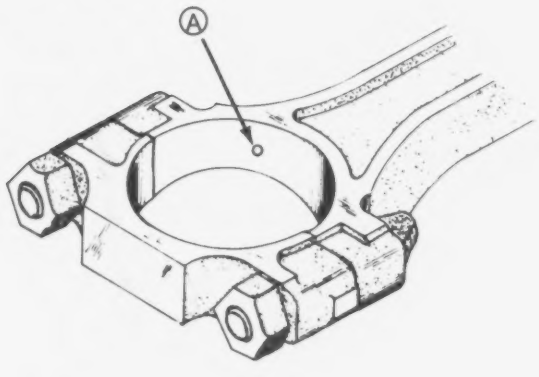


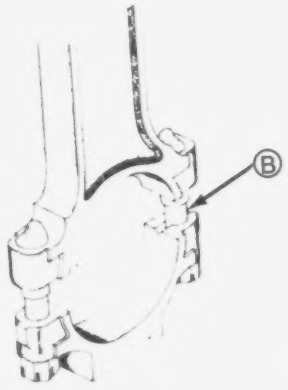
5. Detonation

6. Lose piston pin lock ring

P. Fill in the missing words in the statements below.

Cylinder walls and piston pins can be lubricated three ways. Drawing "A" illustrates the split oil hole method of cylinder lubrication. Drawing "B" shows the V-groove method. The third method of lubrication is called the splash method.





LAP ASSIGNMENT SHEET #1

Q. Match the names and illustrations of the following reconditioning tools shown. Write the correct numbers in the blanks.

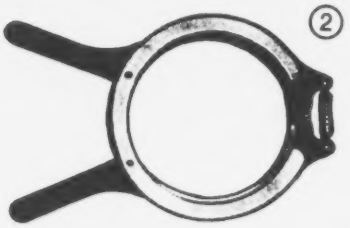
__2__ Ring expander

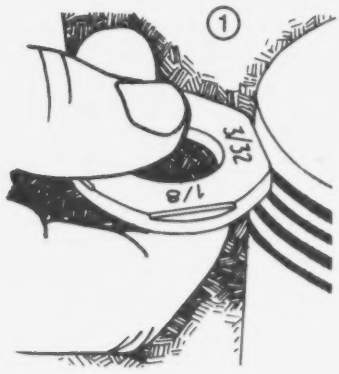
__4__ Boring bar

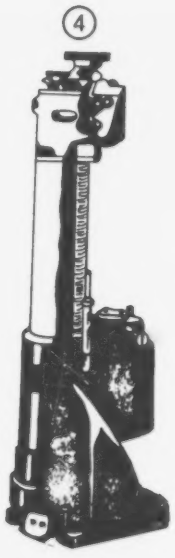
__1__ Ring groove gauge

__5__ Cylinder gauge

__3__ Ring compressor







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LAP ASSIGNMENT SHEET #1

__9__ Piston gauge and scale

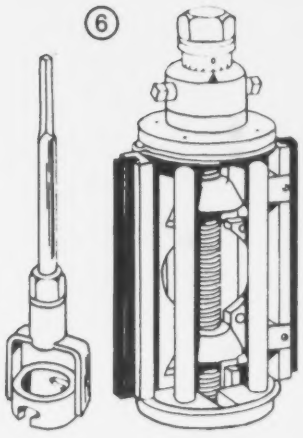
__10__ Sleeve puller and press

__6__ Boring hone

__7__ Glaze breaker hone

__8__ Piston pin press

⑥



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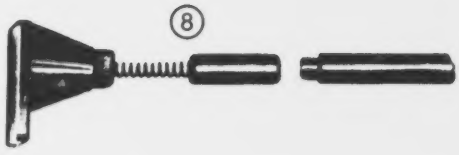

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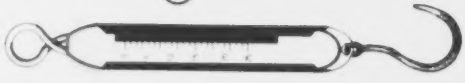

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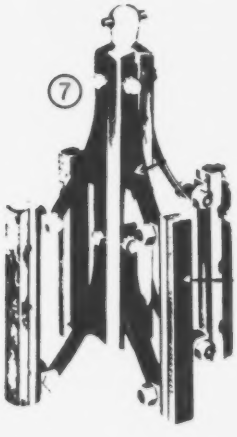
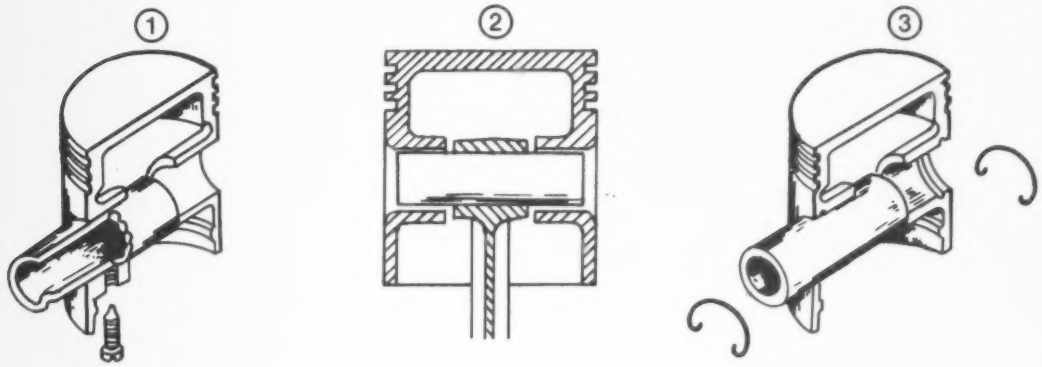
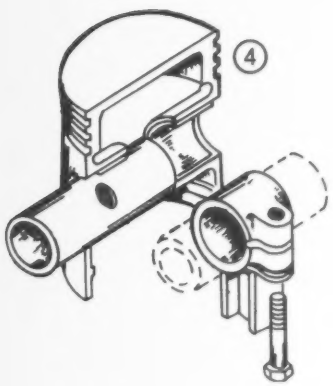


⑩

LAP ASSIGNMENT SHEET #1

R. Match the following illustrations of piston pin locks and their names. Write the correct numbers in the blanks.





2 Press fit in rod

3 Free floating

4 Locked to connecting rod

1 Locked to piston

S. Stop. Have your instructor evaluate your assignment sheet and mark the area(s) below requiring additional study.

Refer to Information Sheet, Section(s)

____ I	____ V	____ IX	____ XIII	____ XVII
____ II	____ VI	____ X	____ XIV	
____ III	____ VII	____ XI	____ XV	
____ IV	____ VIII	____ XII	____ XVI	

If none of the above sections are checked, proceed to Learning Step 6. Otherwise, study the required section(s) and then continue to Learning Step 5.

SECTION A--ENGINE REBUILDING
UNIT VI--CYLINDER AND PISTON RECONDITIONING

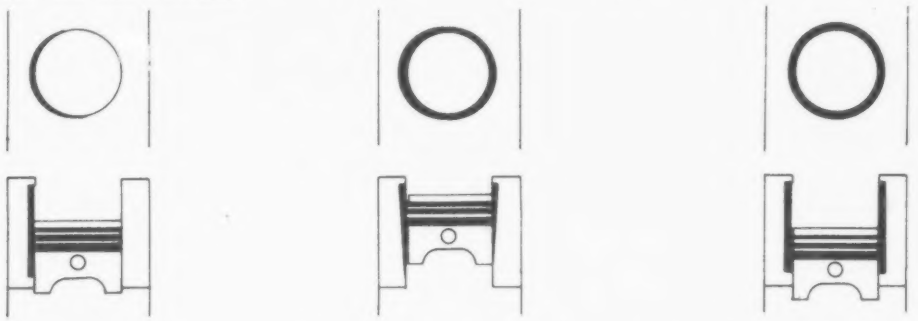
LAP ASSIGNMENT SHEET #2

NAME _____ SCORE _____

A. Identify the terms for the definitions given below. Write the correct terms in the blanks.

1. Knurl - Cross-hatched, roughened metal surface.
2. Ring ridge - Cylinder area above upper travel limit of rings.
3. Cylinder hone - Cleans and smooths inside of cylinder.
4. Lifter valley - Area between cylinder bores on a V-block engine.
5. Ring expander - Used to install piston rings.
6. Bore - Diameter of a hole
7. Oil control ring - Controls how much oil enters combustion chamber.
8. Pop-up - Raised area of piston head.
9. Piston slap - Caused by excessive piston skirt clearance.
10. Cylinder block - Basic framework of the engine.
11. Ream - To enlarge a hole to a specific size.
12. Blow-by - Combustion gases the leak into crankcase.
13. Lands - Area of piston between ring grooves.

B. Identify the cylinder wear patterns shown below. Write the names of the patterns in the blanks.

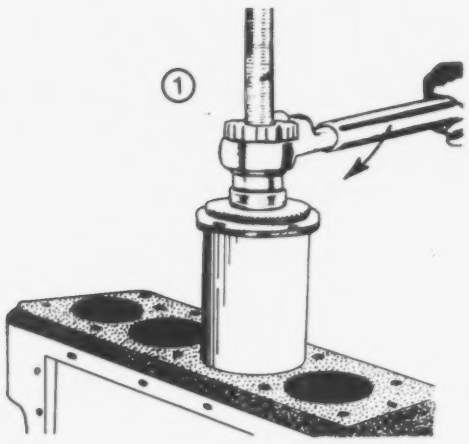


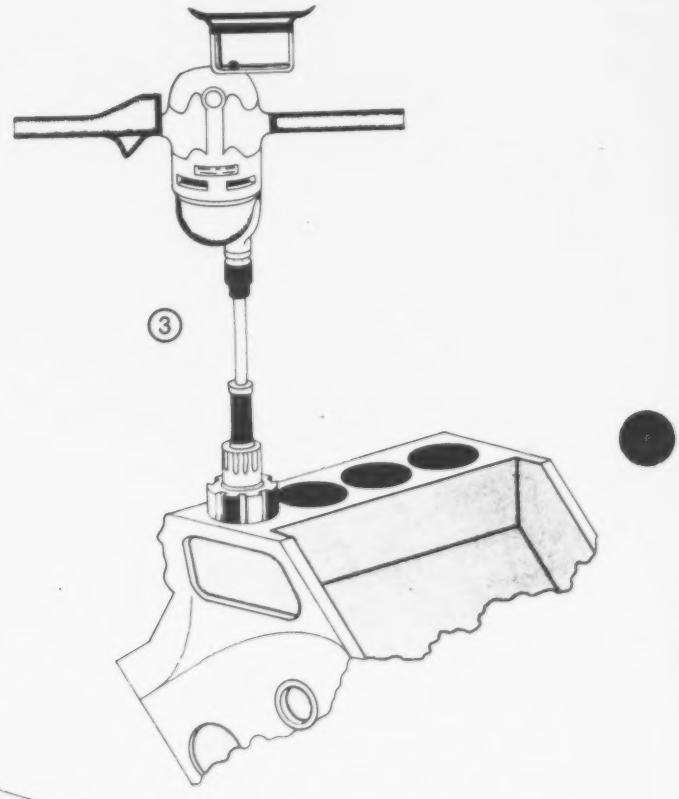
1. Out-of-round 2. Taper 3. Wear

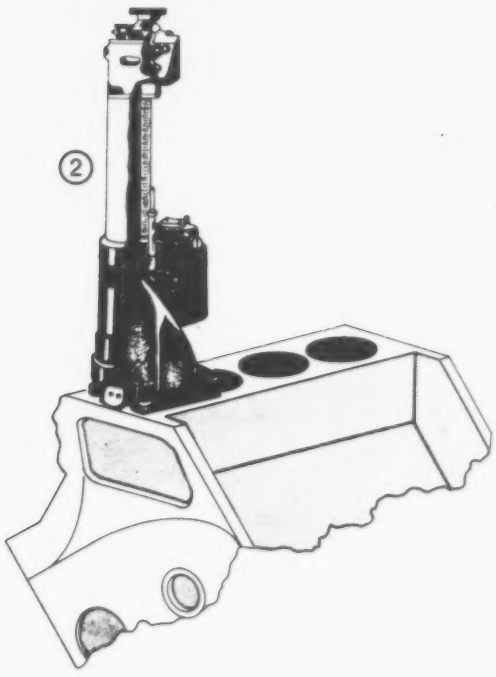
LAP ASSIGNMENT SHEET #2

C. Match the names and illustrations of methods of cylinder reconditioning shown below. Write the correct numbers in the blanks.

_3_ Hone _2_ Bore _1_ Sleeve replacement





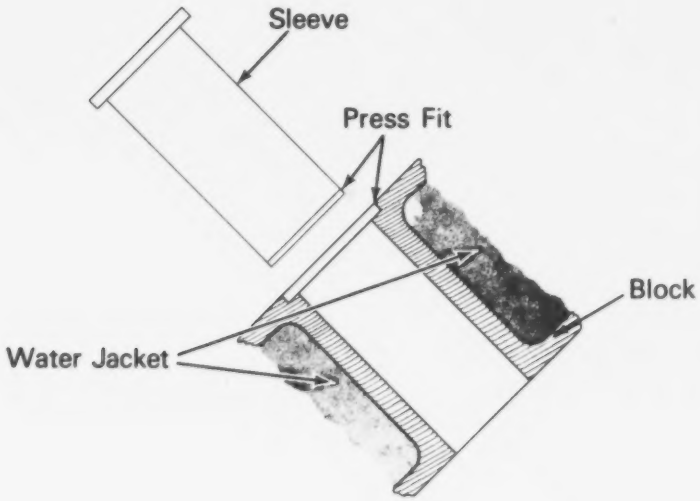


LAP ASSIGNMENT SHEET #2

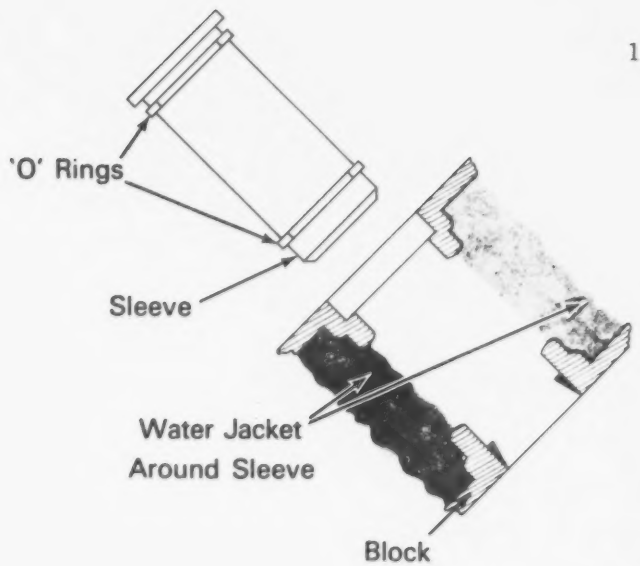
D. Fill in the missing words in the statement below.

The two basic types of cylinder sleeves are the ___wet___ type and the ___dry___ type.

E. Identify the cylinder sleeves shown below. Write their names in the blanks.



1. Wet



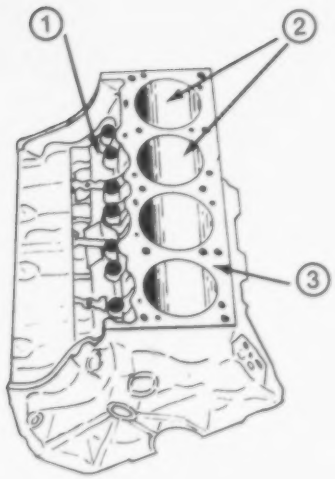
2. Dry

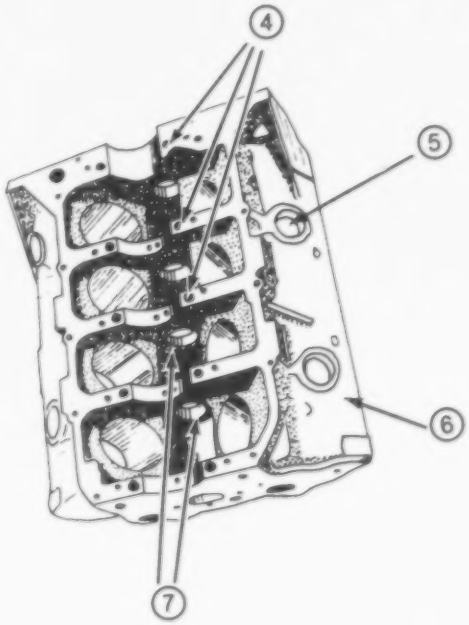
LAP ASSIGNMENT SHEET #2

F. Explain why cylinders typically wear into a tapered shape.

Since there is greater piston ring pressure, more friction, and higher heat concentration, there is more wear at the top of the cylinder

G. Identify the numbered parts of the two engine blocks shown below. Write the correct names of the parts in the corresponding blanks.

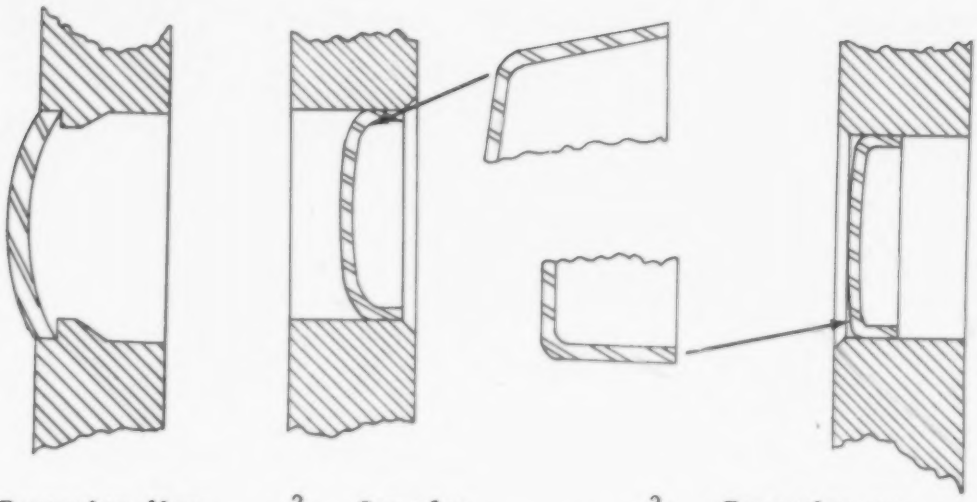




1. Lifter valley
2. Cylinders
3. Head mating surface
4. Main bearing suport
5. Core holes
6. Water jacket
7. Camshaft bore

LAP ASSIGNMENT SHEET #2

H. Identify the core plugs shown below. Write the names of the plugs in the blanks below the drawings.



1. Expansion disc 2. Cup plug 3. Expansion cup

I. Match the names and the numbered parts of the piston shown below. Write the correct numbers in the blanks.

3 Head

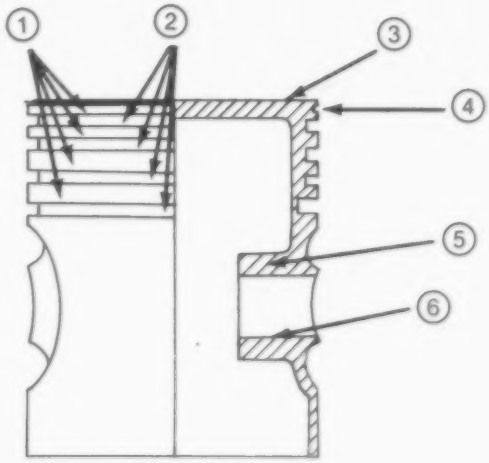
6 Pin bearing

1 Lands

2 Ring grooves

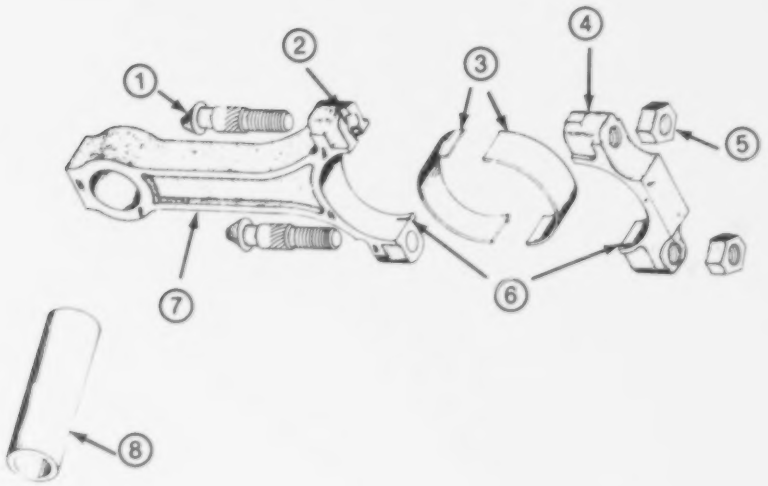
4 Heat clam

5 Pin boss



LAP ASSIGNMENT SHEET #2

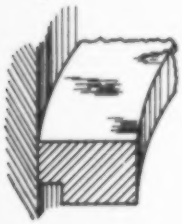
J. Match the names and the numbered parts of the rod assembly illustrated below. Write the correct numbers in the blanks.



8 Pin	1 Bolt
4 Cap	2 Spit hole
5 Nut	6 Lock groove
3 Bearing insert	7 Rod

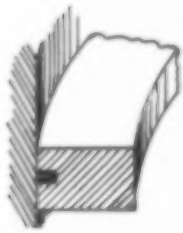
LAP ASSIGNMENT SHEET #2

K. Identify the compression rings shown below. Write their correct names in the blanks.



1. Scraper

2. Plain



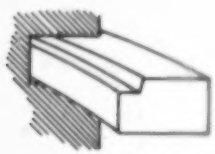
3. Center grooved

4. Tapered

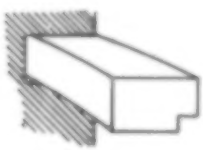
5. Chamfered

6. Counterbored

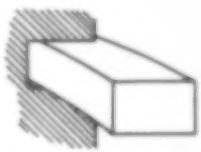
L. Identify the following methods of installing compression rings. Write their correct names in the blanks.



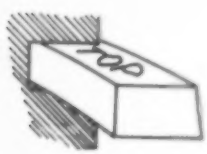
1. Outside groove up



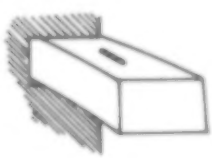
2. Outside groove down



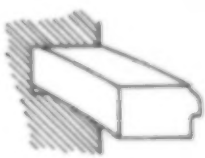
3. Either side up



4. "Top" up



5. Dash or dot up



6. Scraper edge down

LAP ASSIGNMENT SHEET #2

M. Identify the oil rings shown below. Write their names in the blanks.

1. Drilled

2. Three-piece

3. Slotted

4. Radius slotted

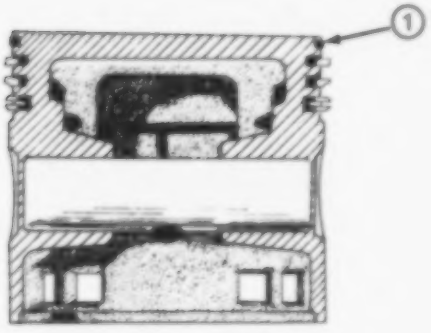
5. Wedge slotted

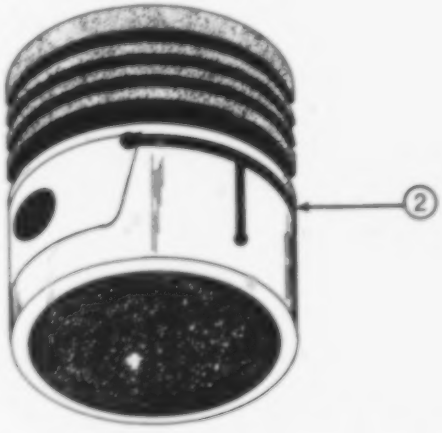
N. Match types of oil rings and their proper methods of installation. Write the correct letters in the blanks.

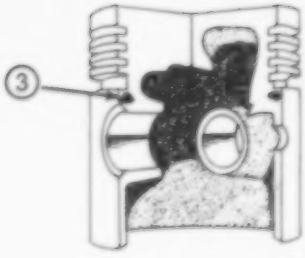
b	1. Expander gap 180° from ring gap	a. One piece
a	2. Either side up	b. Two piece
c	3. Steel rail gaps 180° apart and 90° from expander gap	c. Three piece

LAP ASSIGNMENT SHEET #2

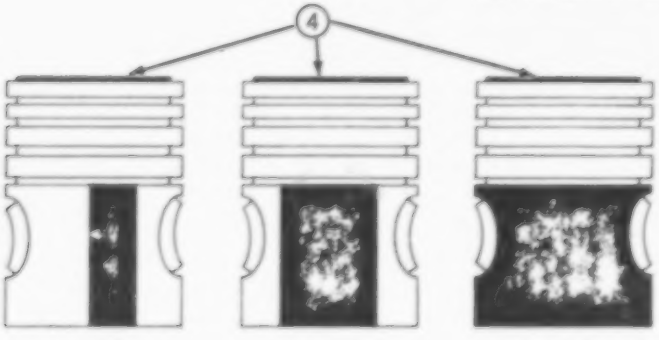
0. Identify the four methods of piston heat and expansion control shown below. Write the names of the methods in the corresponding blanks.





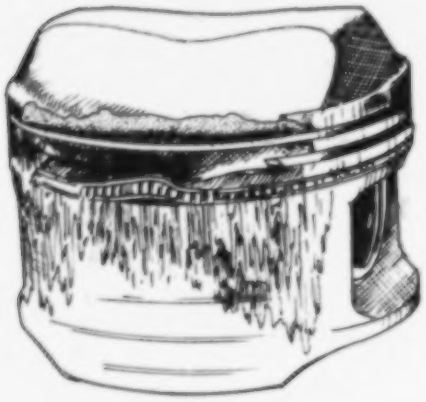


1. Heat dam
2. Slotted
3. Steel belt or band
4. Cam ground

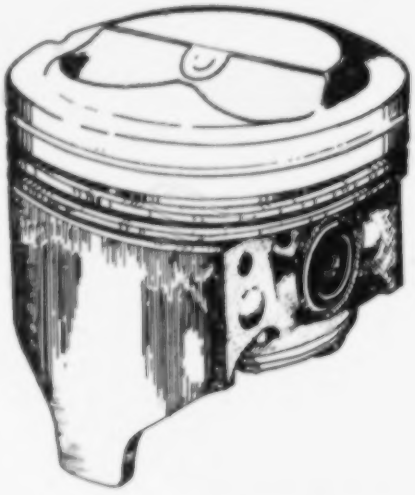


LAP ASSIGNMENT SHEET #2

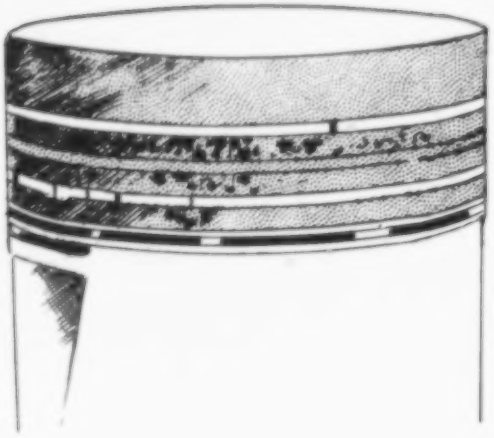
P. Identify the causes of the damaged pistons shown below and on the next page. Write the causes in the blanks below the drawings.



1. Detonation



2. Misaligned connecting rod



3. Stuck piston rings

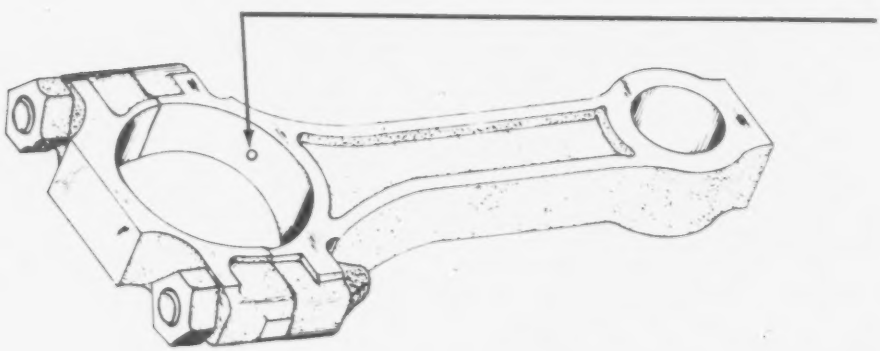
4. Loose lock ring

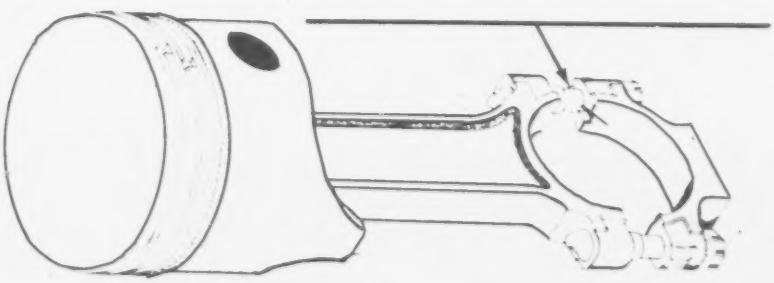
LAP ASSIGNMENT SHEET #2

5. Preignition

6. Broken ring

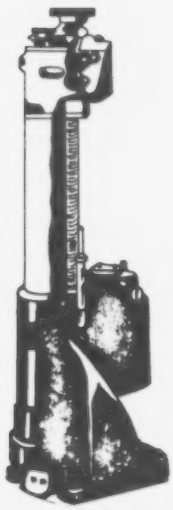
Q. Identify the illustrated methods of cylinder wall lubrication. Write the correct names of the methods in the blanks.



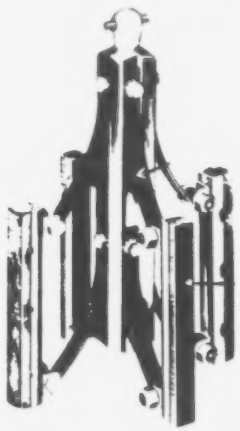


LAP ASSIGNMENT SHEET #2

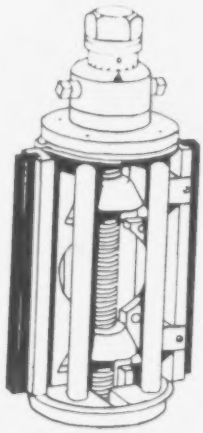
R. Identify these cylinder and piston reconditioning tools. Write their names in the blanks below the drawings.



1. Boring bar

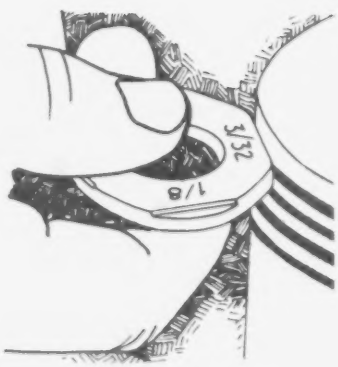


2. Glaze breaker hone



3. Boring hone

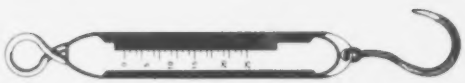
4. Cylinder gauge

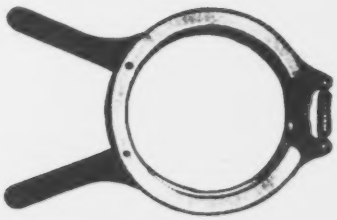


5. Ring groove gauge

6. Piston pin press

LAP ASSIGNMENT SHEET #2





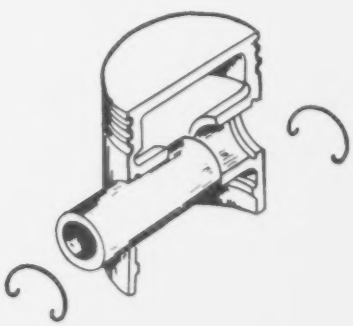
7. Piston gauge and scale

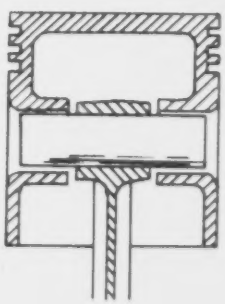
8. Ring expander

9. Ring compressor

10. Sleeve puller and press

S. Identify the following illustrations of piston pin locks. Write their names in the blanks.

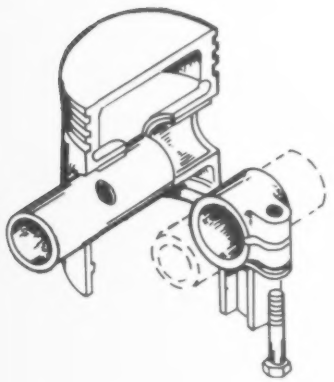


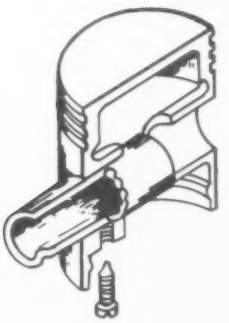


1. Free floating

2. Press fit

LAP ASSIGNMENT SHEET #2





3. Locked to rod

4. Locked to piston

T. Stop. Have your instructor evaluate your assignment sheet. If your instructor is satisfied with your progress, continue to Learning Step 6. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to Learning Step 6.

State Department of Vocational and Technical Education CIMC Stillwater, Oklahoma LEARNING ACTIVITY PACKETS

for AUTO MECHANICS II

LAP NO. _____ CODE: _____

MAJOR INSTRUCTIONAL AREA SECTION A--ENGINE REBUILDING

INSTRUCTIONAL UNIT UNIT VII--ENGINE REASSEMBLY

LEARNING ACTIVITY PACKET NO. 7

PREREQUISITE LAP(S) 3

PURPOSE: This Learning Activity Packet (LAP) outlines the study activities and performance tasks for "Engine Reassembly." Accomplishing these procedures will aid the student in attaining a working knowledge of this area of training, and in achieving a Skilled or Moderately Skilled competency level in the performance of jobs associated with this specialty.

INTRODUCTION: The course of study in this LAP will help the student become able to assemble and adjust all parts and component groups of an engine while observing all safety precautions and maintaining a clean and orderly work area.

TASKS INCLUDED IN THIS LAP:

1. Install camshaft and bearings.
2. Install crankshaft, bearings, timing gears, and timing cover.
3. Install pistons and connecting rod assemblies.
4. Install oil pump, pickup screen, and oil pan.
5. Install cylinder head, intake manifold, and exhaust manifold.
6. Install engine accessory components.

SECTION A--ENGINE REBUILDING
UNIT VII--ENGINE REASSEMBLY

LEARNING STEPS

Check the following blanks as you complete the required steps.

_____ 1. Read — Unit and Specific Objectives, page AM II-313-A.

_____ 2. Complete — Engine Reassembly Pretest, LAP page 11.

_____ 3. Study — The sections of the Information Sheet, page AM II-317-A, indicated by your instructor on you Pretest. Be sure to study the transparency masters when required.

_____ 4. Do — LAP Assignment Sheet #1, LAP page 15.

_____ 5. Do — LAP Assignment Sheet #2, LAP page 17.

_____ 6. Check — The following tasks which you feel that you can perform without supervision.

Student Check		Instructor Initials/Date Skilled	Moderately Skilled
_____a.	Install camshaft and bearings. (9)	_____	_____
_____b.	Install crankshaft, bearings, timing gears, and timing cover. (15)	_____	_____
_____c.	Install pistons and connecting rod assemblies. (21)	_____	_____
_____d.	Install oil pump, pickup screen, and oil pan. (27)	_____	_____

LEARNING STEPS

Student Check		Instructor Initials/Date Skilled	Moderately Skilled
_____e.	Install cylinder head, intake manifold, and exhaust manifold. (33)	_____	_____
_____f.	Install engine accessory components. (39)	_____	_____

_____ 7. Discuss — Your competency in each task with your instructor. Your instructor will initial each task in which you demonstrate sufficient competency. If all tasks have been initialed, proceed to Learning Step 45. Otherwise, continue to Learning Step 8.

_____ 8. Refer — To Learning Step 6a. If this task has been initialed, proceed to Learning Step 14. Otherwise, continue to Learning Step 9.

_____ 9. Study — Job Sheet #1--Install Camshaft and Bearings, pages AM II-321-A through 324-A.

_____10. Watch — Slide/tape presentation, "Install Camshaft and Bearings." (A-VII-1)

_____11. Do — Job Sheet #1--Install Camshaft and Bearings.

_____12. Stop. — Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 6a and proceed to Learning Step 14. Otherwise, repeat Learning Steps 9 through 11 and then continue to Learning Step 13.

_____13.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 6a and continue to Learning Step 14. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 6a and continue to Learning Step 14.
_____14.	Refer	To Learning Step 6b. If this task has been initialed, proceed to Learning Step 20. Otherwise, continue to Learning Step 15.
_____15.	Study	Job Sheet #2--Install Crankshaft, Bearings, Timing Gears, and Timing Cover, pages AM II-325-A through AM II-331-A.
_____16.	Watch	Slide/tape presentation, "Install Crankshaft, Bearings, Timing Gears, and Timing Cover." (A-VII-2)
_____17.	Do	Job Sheet #2--Install Crankshaft, Bearings, Timing Gears, and Timing Cover.
_____18.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 6b and proceed to Learning Step 20. Otherwise, repeat Learning Steps 15 through 17 and then continue to Learning Step 19.
_____19.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 6b and continue to Learning Step 20. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 6b and continue to Learning Step 20.

_____20.	Refer	To Learning Step 6c. If this task has been initialed, proceed to Learning Step 26. Otherwise, continue to Learning Step 21.
_____21.	Study	Job Sheet #3--Install Pistons and Connecting Rod Assemblies, pages AM II-333-A through AM II-341-A.
_____22.	Watch	Slide/tape presentation, "Install Pistons and Connecting Rod Assemblies." (A-VII-3)
_____23.	Do	Job Sheet #3--Install Pistons and Connecting Rod Assemblies.
_____24.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 6c and proceed to Learning Step 26. Otherwise, repeat Learning Steps 21 through 23 and then continue to Learning Step 25.
_____25.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 6c and continue to Learning Step 26. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 6c and continue to Learning Step 26.
_____26.	Refer	To Learning Step 6d. If this task has been initialed, proceed to Learning Step 32. Otherwise, continue to Learning Step 27.
_____27.	Study	Job Sheet #4--Install Oil Pump, Pickup Screen, and Oil Pan, pages AM II-343-A and 344-A.

LEARNING STEPS

_____28.	Watch	Slide/tape presentation, "Install Oil Pump, Pickup Screen, and Oil Pan." (A-VII-4)
_____29.	Do	Job Sheet #4--Install Oil Pump, Pickup Screen, and Oil Pan.
_____30.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 6d and proceed to Learning Step 32. Otherwise, repeat Learning Steps 27 through 29 and then continue to Learning Step 31.
_____31.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 6d and continue to Learning Step 32. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 6d and continue to Learning Step 32.
_____32.	Refer	To Learning Step 6e. If this step has been initialed proceed to Learning Step 38. Otherwise, continue to Learning Step 33.
_____33.	Study	Job Sheet #5--Install Cylinder Head, Intake Manifold, and Exhaust Manifold, pages AM II-345-A through 350-A.
_____34.	Watch	Slide/tape presentation, "Install Cylinder Head, Intake Manifold, and Exhaust Manifold." (A-VII-5)
_____35.	Do	Job Sheet #5--Install Cylinder Head, Intake Manifold, and Exhaust Manifold.

_____36.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have you instructor initial Learning Step 6e and proceed to Learning Step 38. Otherwise, repeat Learning Steps 33 through 35 and continue to Learning Step 37.
_____37.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 6e and continue to Learning Step 38. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 6e and continue to Learning Step 38.
_____38.	Refer	To Learning Step 6f. If this step has been initialed proceed to Learning Step 44. Otherwise, continue to Learning Step 39.
_____39.	Study	Job Sheet #6--Install Engine Accessory Components, pages AM II-351-A and 352-A.
_____40.	Watch	Slide/tape presentation, "Install Engine Accessory Components." (A-VII-6)
_____41.	Do	Job Sheet #6--Install Engine Accessory Components.
_____42.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 6f and proceed to Learning Step 44. Otherwise, repeat Learning Steps 39 through 41 and then continue to Learning Step 43.

_____43. Stop. Have you instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 6e. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 6e and continue to Learning Step 44.

_____44. Refer To Learning Step 6. If all tasks have been initialed, continue to Learning Step 45. Otherwise, refer to the step indicated in parentheses after the unsigned task.

_____45. Review Information Sheet (page AM II-317-A) and LAP Assignment Sheets.

_____46. Take Engine Reassembly Test (see your instructor). If your score is 85 percent or above, continue to the next assigned Learning Activity Packet. Otherwise, ask your instructor about additional study requirements and possible retesting.

SECTION A--ENGINE REBUILDING
UNIT VII--ENGINE REASSEMBLY

PRETEST

NAME _____ SCORE _____

DIRECTIONS: This pretest is to determine how much you already know about engine reassembly. Your performance on this pretest will not be used to determine your grade in the course. Instead, it will guide your instructor in designing this course to meet your needs. If you are unsure of the answer to a question, do not guess. Guessing may prevent you from receiving needed instruction.

1. Define the following terms.

   a. TDC (top dead center)-- Maximum upper limit of piston travel in the cylinder

   b. Lubriplate-- Lithium-based lubricant with high-impact and temperature stability qualities

   c. Torque sequence-- Tightening pattern of nuts or bolts that allows even tightening at all points

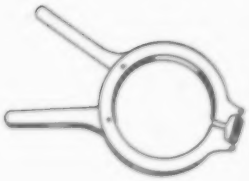
   d. Tolerance-- Acceptable variation in measurement of two related working parts

   e. Gasket-- Seal made of cork or metal; placed between two machined surfaces

2. Identify the following tools used in engine reassembly. Write the names of the tools in the blanks below the drawings.

a. Push rod installer

b. Valve lifter installing tool



c. Ring expander

d. Torque wrench

e. Ring compressor

f. Vibration damper tool

g. Piston pin press

h. Camshaft bearing tool

i. Rear main bearing seal installer

3. Give five reasons for torquing nuts and bolts to specifications.

   a. To prevent overtightening (stretching) of bolts

   b. To prevent distortion of mating surfaces

   c. To prevent thread damage

   d. To prevent leaks caused by uneven mating surfaces

   e. To prevent distortion of cylinder walls

4. Stop. Have your instructor evaluate your pretest and mark the area(s) below requiring additional study.

   Refer to Information Sheet, Section(s)

   ____ I ____ II ____ III

   You came here from Learning Step 2. If none of the above sections are checked, proceed to Learning Step 6. Otherwise, continue to Learning Step 3.

SECTION A--ENGINE REBUILDING
UNIT VII--ENGINE REASSEMBLY

LAP ASSIGNMENT SHEET #1

NAME _____ SCORE _____

A. Match the following terms and definitions. Write the correct letters in the blanks.

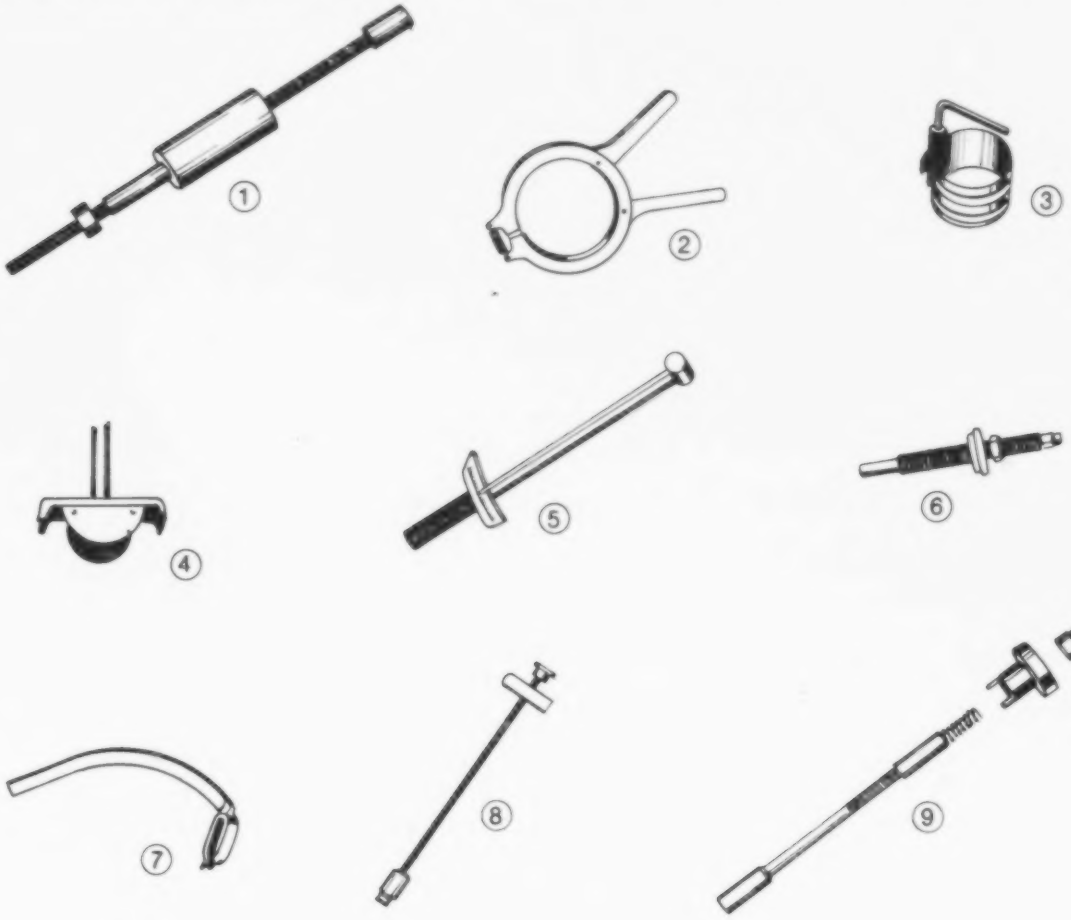
E	1. Grease	a.	TDC
B	2. Provides seal between machined surfaces	b.	Gasket
C	3. Acceptable variation of fit or measurement	c.	Tolerance
D	4. Tightening pattern	d.	Torque sequence
A	5. Upper limit of piston travel	e.	Lubriplate

B. List five problems which can be prevented by following proper torque sequence and specifications.

1. Overtightened (atretched) bolts
2. Distorted mating surfaces
3. Leaks
4. Thread damage
5. Cylinder wall distortion

C. Match names of engine reassembly tools and their illustrations. Write the correct numbers in the blanks.

9 Piston pin press	5 Torque wrench
6 Vibration damper tool	3 Ring compressor
2 Ring expander	1 Camshaft bearing tool
8 Valve lifter installing tool	4 Rear main bearing seal installer
7 Push rod installer	



D. Stop. Have your instructor evaluate your assignment sheet and mark the area(s) below requiring additional study.

Refer to Information Sheet, Section(s)

_____ I _____ II _____ III

If none of the above sections are checked, proceed to Learning Step 6. Otherwise, continue to Learning Step 5.

SECTION A--ENGINE REBUILDING
UNIT VII--ENGINE REASSEMBLY

LAP ASSIGNMENT SHEET #2

NAME _____ SCORE _____

A. Define the terms listed below.

1. Lubriplate--Lithium-based lubricant

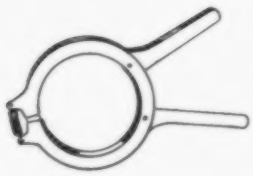
2. Gasket--Seal between machined surfaces

3. TDC--Upper limit of piston travel

4. Tolerance--Acceptable variation in fit or measurement

5. Torque sequence--Order of tightening bolts or nuts

B. Identify the special tools shown in the following illustrations. Write their correct names in the blanks.



1. Ring expander 2. Torque wrench 3. Ring compressor

4. Cam bearing tool

5. Piston pin press

6. Rear main bearing seal installer

7. Vibration damper tool

8. Valve lifter installer

9. Push rod installer

C. Fill in the missing words in the paragraph below.

When torqueing bolts they must be tightened a **specific** amount and in a specific **order**. Following the proper **torque** **sequence** prevents overtightened **bolts**, distorted **mating** surfaces which can result in oil and/or coolant **leaks**, thread damage, and cylinder wall **distortion**.

D. Stop. Have your instructor evaluate your assignment sheet. If your instructor is satisfied with your progress, continue to Learning Step 6. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to Learning Step 6.

State Department of Vocational and Technical Education CIMC Stillwater, Oklahoma LEARNING ACTIVITY PACKETS

for AUTO MECHANICS II

LAP NO. _____ CODE: _____

MAJOR INSTRUCTIONAL AREA SECTION A--ENGINE REBUILDING

INSTRUCTIONAL UNIT UNIT VIII--ENGINE INSTALLATION

LEARNING ACTIVITY PACKET NO. 8

PREREQUISITE LAP(S) 2

PURPOSE: This Learning Activity Packet (LAP) outlines the study activities and performance tasks for "Engine Installation." Accomplishing these procedures will aid the student in attaining a working knowledge of this area of training and in achieving a SKILLED or MODERATELY SKILLED competency level in the performance of jobs associated with this specialty.

INTRODUCTION: The course of study in this LAP will help the student become able to install a completely assembled engine and make all necessary connections and adjustments before returning the vehicle to the customer.

TASKS INCLUDED IN THIS LAP:

1. Install engine with automatic transmission.
2. Install engine with standard transmission.
3. Adjust and start newly installed engine.

SECTION A--ENGINE REBUILDING
UNIT VIII--ENGINE INSTALLATION

LEARNING STEPS

Check the following blanks as you complete the required steps.

_____ 1. Read — Unit and Specific Objectives, page AM II-357-A.

_____ 2. Complete — Engine Installation Pretest, LAP page 7.

_____ 3. Study — The sections of the Information Sheet (pages AM II-361-A and 362-A) indicated by your instructor on your Pretest.

_____ 4. Do — LAP Assignment Sheet #1, LAP page 9.

_____ 5. Do — LAP Assignment Sheet #2, LAP page 11.

_____ 6. Check — The tasks below which you feel that you can perform without supervision.

Student Check		Instructor Initials/Date: Skilled	Moderately Skilled
_____	a. Install engine with automatic transmission. (9)	_____	_____
_____	b. Install engine with standard transmission. (15)	_____	_____
_____	c. Adjust and start newly installed engine. (21)	_____	_____

LEARNING STEPS

_____ 7.	Discuss	Your competency in each task with your instructor. Your instructor will initial each task in which you demonstrate sufficient competency. If all tasks have been initialed, proceed to Learning Step 27. Otherwise, continue to Learning Step 8.
_____ 8.	Refer	To Learning Step 6a. If this task has been initialed, proceed to Learning Step 14. Otherwise, continue to Learning Step 9.
_____ 9.	Study	Job Sheet #1--Install Engine with Automatic Transmission, pages AM II-363-A through 366-A.
_____10.	Watch	Slide/tape presentation, "Install Engine with Automatic Transmission." (A-VIII-1)
_____11.	Do	Job Sheet #1--Install Engine with Automatic Transmission.
_____12.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 6a and proceed to Learning Step 14. Otherwise, repeat Learning Steps 9 through 11 and then continue to Learning Step 13.
_____13.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 6a and continue to Learning Step 14. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Learning Step 6a and continue to Learning Step 14.
_____14.	Refer	To Learning Step 6b. If this step has been initialed proceed to Learning Step 20. Otherwise, continue to Learning Step 15.

LEARNING STEPS

_____15.	Study	Job Sheet #2--Install Engine with Standard Transmission, pages AM II-367-A through 370-A.
_____16.	Watch	Slide/tape presentation, "Install Engine with Standard Transmission." (A-VIII-2)
_____17.	Do	Job Sheet #2--Install Engine with Standard Transmission.
_____18.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 6b and proceed to Learning Step 20. Otherwise, repeat Learning Steps 15 through 17 and then continue to Learning Step 19.
_____19.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 6b and continue to Learning Step 20. If additional study is required, discuss a study program with your instructor. After you complete that program to your instructor's satisfaction, have your instructor initial Learning Step 6b and continue to Learning Step 20.
_____20.	Refer	To Learning Step 6c. If this task has been initialed proceed to Learning Step 26. Otherwise, continue to Learning Step 21.
_____21.	Study	Job Sheet #3--Adjust and Start Newly Installed Engine, pages AM II-371-A and 372-A.
_____22.	Watch	Slide/tape presentation, "Adjust and Start Newly Installed Engine." (A-VIII-3)
_____23.	Do	Job Sheet #3--Adjust and Start Newly Installed Engine.

_____24.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 6c and proceed to Learning Step 26. Otherwise, repeat Learning Steps 21 through 23 and then continue to Learning Step 25.
_____25.	Stop.	Have your instructor evaluate your work. If you achieve a Skilled or Moderately Skilled rating, have your instructor initial Learning Step 6c and continue to Learning Step 26. If additional study is required, discuss a study program with your instructor. After you complete that program to your instructor's satisfaction, have your instructor initial Learning Step 6c and continue to Learning Step 26.
_____26.	Refer	To Learning Step 6. If all tasks have been initialed, continue to Learning Step 27. Otherwise, refer to the step indicated in parentheses after the unsigned task.
_____27.	Review	Information Sheet (pages AM II-361-A and 362-A) and LAP Assignment Sheets.
_____28.	Take	Engine Installation Test (see your instructor). If your score is 85 percent or above, continue to the next assigned Learning Activity Packet. Otherwise, ask your instructor about additional study requirements and possible retesting.

SECTION A--ENGINE REBUILDING
UNIT VIII--ENGINE INSTALLATION

PRETEST

NAME _____ SCORE _____

DIRECTIONS: This pretest is to determine how much you already know about engine installation. Your performance on this pretest will not be used to determine your grade in the course. Instead, it will guide your instructor in designing this course to meet your needs. If you are unsure of the answer to a question, do not guess. Guessing may prevent you from receiving needed instruction.

1. Define the following terms.

   a. Engine break-in-- Procedure used to help frictional surfaces adjust to each other

   b. Lug an engine-- To heavily load the engine so that under acceleration it does not gain speed

   c. Road test-- Driving a vehicle at various speeds and road conditions to determine the condition of the vehicle

2. Give five safety rules to follow during engine installations.

   a. Avoid gas spills; clean them up immediately if they occur

   b. Avoid electrical sparks, especially around the battery

   c. Get help when moving heavy weights

   d. Keep clear of an engine on a hoist

   e. Never work underneath the vehicle when its engine is on a hoist

3. Give four steps to consider when planning an engine installation.

   ANSWER SHOULD INCLUDE ANY FOUR OF THE FOLLOWING.

   a. Make sure that work area is sufficient

   b. Have ordered plan of reassembly

   c. Use proper tools and equipment

   d. Use manufacturer's specifications for all necessary adjustments

   e. Know your job

4. Give five items to check or adjust before starting a newly installed engine.

   ANSWER SHOULD INCLUDE ANY FIVE OF THE FOLLOWING.

   a. Coolant level

   b. Oil level

   c. Valves

   d. Ignition point dwell (gap)

   e. Ignition timing

   f. Engine idle

5. List four of the things a break-in procedure should include.

   a. Check all fluid levels

   b. Check tune-up adjustments

   c. Perform road test

   d. Check engine and accessories for oil, coolant, or fuel leaks

6. Stop. Have your instructor evaluate your pretest and mark the area(s) below requiring additional study.

   Refer to Information Sheet, Section(s)

   ____ I ____ III ____ V

   ____ II ____ IV

   You came here from Learning Step 2. If none of the above sections are checked, proceed to Learning Step 6. Otherwise, continue to Learning Step 3.

SECTION A--ENGINE REBUILDING
UNIT VIII--ENGINE INSTALLATION

LAP ASSIGNMENT SHEET #1

NAME_____ SCORE_____

A. Match the terms and definitions listed below. Write the correct letters in the blanks.

B	1. Driving test	a.	Lug an engine
C	2. Engine overloading	b.	Engine break-in
A	3. Helps frictional parts adjust	c.	Road test

B. List five safety rules to follow during engine installation.

1. Avoid gas spills; clean up immediately
2. Avoid electrical sparks, especially around the battery
3. Get help when lifting or moving heavy loads
4. Keep clear of an engine supported on a hoist
5. Never work under a vehicle while its engine is supported on a hoist

C. List four steps to consider when installing an engine.

ANSWER SHOULD INCLUDE ANY FOUR OF THE FOLLOWING.

1. Ample work space for vehicle and equipment is provided
2. Proper tools and equipment are available
3. Adjustment specifications are available
4. Installation steps are planned
5. You know your job

D. List five things to check before starting a newly installed engine.

ANSWER SHOULD INCLUDE ANY FIVE OF THE FOLLOWING.

1. Coolant level
2. Oil level
3. Valves

4. **Ignition point dwell**

5. **Ignition timing**

6. **Engine idle**

E. List four parts of a break-in procedure.

1. **Road test vehicle**

2. **Check all fluid levels**

3. **Make tune-up adjustments**

4. **Check for loose brackets, belts, nuts and bolts**

F. Stop. Have your instructor evaluate your Assignment Sheet and mark the area(s) below requiring additional study.

Refer to Information Sheet, Section(s)

____ I ____ III ____ V

____ II ____ IV

If none of the above sections are checked, proceed to Learning Step 6. Otherwise, study the required section(s) and then continue to Learning Step 5.

SECTION A--ENGINE REBUILDING
UNIT VIII--ENGINE INSTALLATION

LAP ASSIGNMENT SHEET #2

NAME _____ SCORE _____

A. Define the following terms.

1. Road test-- Systematic method of driving under varied conditions in order to determine general vehicle conditions
2. Engine break-in-- Procedure to help frictional surfaces adjust to each other
3. Lug an engine-- To load the engine so much that it cannot accellerate the vehicle

B. Fill in the missing words in the following paragraphs.

1. Before installing an engine there are several planning steps to follow. Be sure you have enough work space for equipment and vehicle. You should have a precise plan of action. Obtain the proper tools and equipment. You should also know all the engine's specifications for adjustments.
2. During an engine installation avoid gas spills and electrical sparks around the battery. Keep clear of the engine while it is on a hoist, and do not work under the vehicle until it is securely installed.

3. Some of the items to check before starting a newly installed engine include coolant level and oil level. The valves, point dwell, timing, and engine idle should also be adjusted.

C. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your progress, continue to Learning Step 6. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to Learning Step 6.